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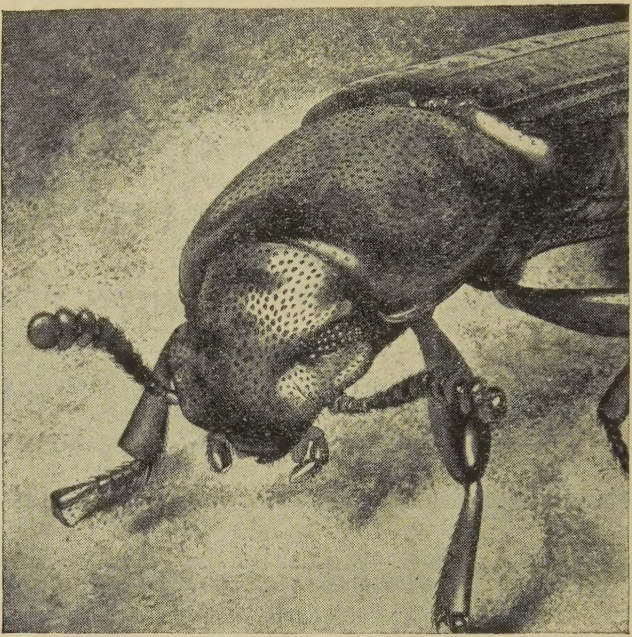

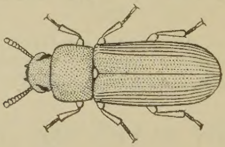

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Park (T.). **Experimental Studies of Interspecies Competition. I. Competition between Populations of the Flour Beetles,** *Tribolium confusum* **Duval and** *Tribolium castaneum* **Herbst.**—*Ecol. Monogr.* **18** no. 2 pp. 265–307, 14 figs., 33 refs. Durham, N.C., 1948.

Park (T.) & Frank (M. B.). **The Population History of** *Tribolium* **free of Sporozoan Infection.**—*J. Anim. Ecol.* **19** no. 2 pp. 95–105, 3 figs., 7 refs. London, 1950.

The following is based almost entirely on the author's summary of the first paper. The census history of 211 laboratory populations of *Tribolium confusum* Duv. and *T. castaneum* (Hbst.) maintained separately or together in three different volumes of a medium comprising 95 per cent. sifted whole-wheat flour and 5 per cent. dry brewer's yeast powder was followed for about four years, during which counts were made every 30 days. The medium was renewed at each count, and the cultures were kept at a constant temperature of 29·5°C. [85·1°F.] and a relative humidity of 60–75 per cent. Observations were also made on similar cultures of beetles rendered free from infection by *Adelina tribolii* [*R.A.E.*, A **22** 64–65], a Coccidian parasite that inhabits the haemocoels and tissues of the beetles and becomes distributed as inactive, but infectious, oöcysts throughout the flour. Since this parasite is a potent source of mortality, especially for *T. castaneum*, it was necessary to evaluate the statistical effect of its presence and absence in the ecosystem before the findings could be interpreted.

Infected populations of either species grew successfully and eventually established equilibrium densities that were maintained for the duration of the study. *T. confusum* became stabilised at a higher total density than *T. castaneum*, which showed a marked depression in numbers after about 300 days, from which it typically recovered. This depression is attributed to increased mortality resulting from parasitic infection. Evidence was obtained that density is inversely proportional to the total volume of medium, especially in the case of *T. confusum*. The proportion of adults was higher in populations of *T. confusum* than in *T. castaneum* ; the volume of medium available had little effect on the composition of populations of the latter. Uninfected populations of *T. castaneum* attained equilibrium densities nearly three times as high as those characteristic of infected populations and showed no depression, whereas uninfected populations of *T. confusum* did not differ significantly in total size from the parasitised controls. For both species, adults were about 20 per cent. more numerous in unparasitised than in parasitised cultures. The variability shown by all cultures of single species within and between census counts is discussed.

In cultures in which interspecies competition was established, one species always became extinct, after which the other showed census trends statistically identical with those of the unmixed cultures. The species to die out was typically *T. castaneum* when *Adelina* was present and *T. confusum* when it was absent. The phenomenon of interspecies competition in *Tribolium* and possible ways that the two species could influence each other when together are discussed.

It is recorded in the second paper that the cultures of uninfected *T. castaneum* and *T. confusum* were maintained and studied in the same way for a further two years, making nearly six years in all, during which about 69 generations developed. The following are the authors' conclusions from the whole work. All the populations were successful in that the cultures did not become extinct. *T. castaneum* persisted at a higher mean density than *T. confusum* when both were unparasitised. When parasitism by *A. tribolii* occurred, *T. confusum* was only slightly affected, whereas the mean density of *T. castaneum* was reduced by about 60 per cent. Cultures of *T. castaneum* characteristically persist with a higher percentage of larvae and pupae and a lower percentage of adults than those of *T. confusum*. Both species showed marked fluctuations in total density, but they were less wide in *T. confusum*. It is concluded that the fluctuations result from the operation of interspecies density-dependent factors and not from systematic alteration of the external, physical environment. In general, the means for grouped replicates were found to afford a responsible appraisal of the census pattern described by individual cultures.

GRASSÉ (P.P.). Ed. **Traité de zoologie. Anatomie, systématique, biologie. Tome X. Insectes supérieurs et hémiptéroïdes.**—$9\frac{3}{4} \times 6\frac{1}{2}$ ins., 2 fasc., [9+]1948 pp., 6 col. pls., 1648 figs. (1 col.), many refs. Paris, Masson et Cie, 1951. Price *Fr.* 13,000.

This further volume of a series [*R.A.E.*, A **37** 360] consists of two parts and comprises the sections on Neuropteroidea by L. Berland & P. P. Grassé (pp. 3–69), Mecoptera by P. P. Grassé (pp. 71–124), Trichoptera by R. Despax (pp. 125–173), Lepidoptera by J. Bourgogne (pp. 174–448), Diptera by E. Séguy (pp. 449–744), Siphonaptera by E. Séguy (pp. 745–769), Hymenoptera by L. Berland and F. Bernard (pp. 771–1276) (including a section on Vespoidea by L. Berland & P. P. Grassé (pp. 1127–1174)), Strepsiptera by R. Jeannel (pp. 1277–1299), Psocoptera by A. Badonnel (pp. 1301–1340), Mallophaga by E. Séguy (pp. 1341–1364), Anoplura by E. Séguy (pp. 1365–1384), Homoptera by P. Pesson (pp. 1390–1656), Heteroptera by R. Poisson (pp. 1657–1803) and Thysanoptera by P. Pesson (pp. 1805–1869).

MARTYN (E. J.). **Pasture Insects Investigations. Report on the Occurrence of Pasture Cockchafers in Tasmania, 1949–50.**—*Tasm. J. Agric.* **21** no. 3 pp. 216–221, 3 refs. Hobart, 1950.

Aphodius pseudotasmaniae Given [*cf. R.A.E.*, A **39** 408] caused extensive damage to pasture in the southern midlands of Tasmania for the first time during the winter of 1949. From field collections made in connection with the outbreak, this species, *A. howitti* Hope and *Aphodius* sp. are recorded from several new districts in the island. The outbreak occurred on improved pasture on sandy soil on both flat and hilly ground ; patches of heavy, black freely-cracking soil on level ground were almost free from *A. pseudotasmaniae*, though they contained considerable numbers of larvae of *Oncopera intricata* Wlk. Rainfall during 1949 was only very slightly above the annual average, but its distribution was not normal, and it was $\frac{1}{2}$–1 in. below the monthly average in five of the seven months during which most larval feeding took place. Pastures that had been dressed with superphosphate in the autumn of 1949 were more heavily damaged than those that had not, possibly because the larger number of livestock carried by them resulted in a greater accumulation of dung. In September, 80–90 per cent. of the larvae present were still feeding actively. Prepupae predominated by mid-November, when the pasture began to recover, and pupae in December. In January, most of the adults had emerged, but had not yet left the pupal cells. Adult flights took place in the evening between mid-January and early February. On the two nights on which observations were made, the flights were stopped by wind or rain before it was quite dark ; winds exceeding about 6 miles per hour caused the flight to diminish in intensity, and no beetles were caught at a light-trap, which was, however, operated only under limited conditions. About 90 per cent. of the beetles in flight were females. Feeding appeared to take place soon after flight ; no discrimination was made between sheep, horse and cow dung, provided that it was fresh. The two sexes were present in nearly equal numbers among adults reared in the laboratory and in collections of pupae. Eggs were found in a cell 5 ins. below the surface of the soil on 30th January 1950. A considerable proportion of the larvae found in September were killed by a fungus disease caused by a species of *Cordyceps*.

Dumbleton (L. J.), Kelsey (J. M.) & Hoy (J. M.). **Chemical Control of** *Oxycanus cervinatus* **Walker. IV. Experiments in 1947 Season.**—*N.Z. J. Sci. Tech.* **30** (A) no. 4 pp. 200–205, 3 refs. Wellington, N.Z., 1950.

The poison bait of bran and paris green developed for the control of larvae of *Oxycanus cervinatus* (Wlk.) in pastures in New Zealand [*R.A.E.*, A **33** 183, etc.] has proved effective, especially in grass or clover grown for seed, but owing to difficulty in obtaining supplies of bran, experiments were carried out in 1947 in an attempt to discover a substitute carrier, and also to test the value of DDT and BHC (benzene hexachloride) against the larvae. The following is largely based on the authors' summary of the results. No equally cheap, efficient, and readily available substitute for bran in the bait was discovered. Gristed oats proved fairly effective, but were more costly and more difficult to mix and spread. The attractiveness of sawdust and chaff as carriers was improved by the addition of wheat germ at the rate of 2½ lb. per 50 lb. carrier. DDT dusts and sprays applied to give 0·6 and 0·5 lb. p,p′DDT per acre, respectively, and a BHC dust applied at 0·6 lb. γ isomer per acre all gave approximately the same degree of control and were as effective as the standard bran bait. Both the dusts are costly and require special equipment for application, but the DDT spray was only slightly more expensive than the standard bait.

Clark (L. R.). **The Habitats and Community Relations of the Acrididae of the Trangie District, central western New South Wales.**—*Bull. Commonw. sci. industr. Res. Org. Aust.* no. 250, 20 pp., 3 pls., 2 figs., 10 refs. Melbourne, 1949.

An account is given of field observations on the Acridids present in the Trangie area, New South Wales [*R.A.E.*, A **37** 218–221 ; **38** 45], which includes outbreak centres of *Chortoicetes terminifera* (Wlk.), and on their seasonal distribution and abundance. The 27 species found, including six that are undescribed, are listed, and their relations with particular habitats, defined in terms of pasture and soil types, and with the recognised plant communities of the area are discussed. Eight, including *C. terminifera* and *Austroicetes cruciata* (Sauss.) occurred in all the major habitats, and four, including *C. terminifera*, were abundant throughout the area. *C. terminifera* and *A. cruciata* both possessed considerably greater powers of multiplication than the other Acridids and each at times exerted a limited competitive effect on the numbers of the other ; they appeared not to be significantly influenced by the other species present during the period of observation.

Burnett (G. F.). **Field Observations on the Behaviour of the Red Locust** (*Nomadacris septemfasciata* **Serville) in the solitary Phase.**—*Anti-Locust Bull.* no. 8 [2+]36 pp., 8 figs., 19 refs. London, 1951.

The following is largely the author's summary of observations on two separate populations of *Nomadacris septemfasciata* (Serv.) in the Rukwa Rift Valley, south-western Tanganyika, between September 1948 and April 1949. According to the usual biometric criteria, the locusts were phase *transiens*, close to *solitaria*, in the parent generation and almost extreme *solitaria* in the next generation. Newly-hatched hoppers were present only in certain patches of ground occupied by a small species of *Cyperus*, or at the edges of larger areas covered by *Cynodon* or other short grass. Both types of site had included a large proportion of bare soil at the time the eggs were laid. The process of pairing, the time of day at which it occurs, and the sites chosen for it, which are those used for oviposition, are described. The daily routine of the adults, which is described, was not so rigidly nor so unanimously followed as was that of denser concentrations of *transiens* locusts earlier in the same dry season. Changes in routine took place when breeding began. Some of the daily movements were accounted for by an apparent avoidance of sun temperatures of over 40°C. [104°F.]. The distribution of both adults and hoppers within a given habitat was very uneven, more so than seemed explicable on grounds of variations of habitat alone, and a degree of mutual attraction between individuals is thought to exist. The main feature of distribution in area was the confinement of adult locusts to stands of tall grass or their neighbourhood. Within these stands, the density showed fluctuations in both the populations studied.

Migration of hoppers and young adults with subsequent concentration took place in one only of the populations. This is attributed to the more tangled and less contrasting stands of vegetation inhabited by the less mobile population. The directed movement resulting in concentration is attributed in the case of young fliers to the steadiness of the wind and in the case of hoppers to the uniform lie of the grass due to wind action. Concentration occurred at the down-wind boundary of tall grass and was undoubtedly due to the strong attraction of tall vegetation for the adult locusts. It is likely that this vegetation collected hoppers owing to the slow rate at which they passed through it.

Waloff (Z.) & Rainey (R. C.). **Field Studies on Factors affecting the Displacements of Desert Locust Swarms in eastern Africa.**—*Anti-Locust Bull.* no. 9, pp. [3+] 1–50, 9 figs., 35 refs. London, 1951.

Rainey (R. C.) & Waloff (Z.). **Flying Locusts and Convection Currents.**—*T.c.* pp. 51–70, 37 refs.

The following is virtually the authors' summary of the first paper. Observations on swarms of *Schistocerca gregaria* (Forsk.) and weather were made at a series of localities in Kenya and Somalia during 1946 and 1947. Within the range of environmental conditions encountered, sunshine appeared to be a factor of major importance in the development of flight activity, particularly at the lower air temperatures. Thus forced and spontaneous take-off and sustained flight were all seen in sunshine at air temperatures 6–8°C. [10·8–14·4°F.] lower than in overcast conditions or at night. Such effects of sunshine may often have been primarily thermal, but there is also evidence of other effects of sunshine on flight activity ; in particular, the duration of preceding bright sunshine appeared at times to be a factor of importance in bringing about mass departure. Air temperature appears to have been a major factor in the development of flight activity in the absence of sunshine, and to have had a demonstrable, though less marked, effect in sunshine. Observations of settling at sunset, at air temperatures that were at times higher than those at which sustained flight continued after dark on other occasions, suggest that flight activity may also be affected by factors other than sunshine and air temperature, such as, perhaps, hunger and fatigue. Evaporative cooling of the flying locusts may have contributed to the observed settling of swarms during heavy rain, though the absence of sunshine is also likely to have had a direct effect on such occasions. No evidence was found of any direct effect of atmospheric humidity on flight activity. Evidence of possible effects of wind on flight activity was inconclusive, observations suggesting both stimulating and inhibiting effects being recorded at different times in winds of comparable strength. Indirect evidence was obtained on body temperatures, consistent with observations by other investigators [*R.A.E.*, A **37** 120–121] indicating a minimum thoracic temperature of about 20°C. [68°F.] for forced flight, and suggesting that thoracic temperatures well above 25°C. [77°F.] are necessary for sustained flight. Mass departures from roosting sites were seen at air temperatures ranging from 19 to 26°C. [66·2° to 78·8°F.] and have been recorded elsewhere at air temperatures down to 14·5°C. [58·1°F.]. Evening settling was recorded at air temperatures ranging from 19 to 36°C. [96·8°F.]. From these observations and those of the other investigators [*loc. cit.*], the air temperature at mass departure was found to be very highly correlated with the temperatures recorded for the previous day at the roosting site, particularly the mean, which gave a correlation coefficient of 0·9338 with air temperature at mass departure. These correlations were found, however, largely to represent an inevitable result of the diversity of temperature régime of the localities in which mass departure was observed, and of the fact that air temperature at mass departure necessarily fell between the maximum and minimum for the day at the roosting site. There was no satisfactorily demonstrable effect of preceding day-to-day fluctuations in temperature on the subsequent behaviour of the locusts.

Determinations of the air-speed of a number of individual low-flying locusts in a migrating swarm, from simultaneous observations of the course and track of the locusts and of the strength and direction of the wind, gave a mean value of 11 miles per hour at an air temperature of 31–32°C. [87·8–89·6°F.]. It is suggested that the total air mileage (displacement with regard to the air) likely to be covered during the life of a swarm may substantially exceed its effective geographical displacement, and that much of the flying activity observed may thus be without appreciable effect on geographical displacement. At winds less than the flying speed of locusts, up-wind, down-wind and cross-wind orientations were observed during migration. Up-wind orientations predominated in these observations, but this effect may have been a result of the lower ground-speeds to be expected of swarms flying up-wind, which would increase the probability of their being reached by mobile observers. All five cases of mass departure observed at winds less than the probable air speed of the locusts were roughly into wind, as also were such cases of individual take-off as were closely observed. It is suggested that the flight of the locust may be dependent on the establishment of an air-flow over the extended wings in an anterio-posterior direction, and that take-off would therefore always be facilitated by, and sometimes dependent on, an up-wind orientation. An appropriate mechanism for orientation into wind before take-off is provided by the aerodynamic sense organ recently described by Weis-Fogh. Evidence was obtained on one occasion suggesting that an orientation established in this manner at mass departure was subsequently maintained by gregarious alignment over a period of some hours, despite a changing wind. Observations of the orientation of individual flying locusts on this occasion showed that no appreciable proportion of the considerable recorded variation of orientation represented adjustment to the varying wind to maintain either a constant direction of displacement relative to the ground or a constant orientation to wind direction. Locusts encountering winds in excess of their probable flying speed were seen to alter their course to down-wind. Apart from this effect, and that of taking off and landing into wind, no simple general relation was found between wind and the orientation of flying locusts.

The following is almost entirely the authors' summary of the evidence on the effects of convection currents on flying adults of *S. gregaria* obtained in the course of the observations described in the first paper and from records obtained during the outbreak that occurred in the same region during 1941–47. Records of stratiform and cumuliform swarm structure were compared with the probable vertical extent of convection for each occasion when weather conditions enabled the latter to be estimated. On all occasions when cumuliform swarms were recorded, the estimated vertical extent of convection was more than 3,000 ft., whereas all records of stratiform structure during this period were associated with lower values. An examination of the meteorological data relating to two well-documented aircraft reports of *S. gregaria* flying at 6,000–7,000 ft. above the ground demonstrated that on both occasions convection currents extended from the surface up to at least the height at which the locusts were observed. On an occasion when it was possible to make a few direct measurements of convection currents together with parallel observations on locust behaviour, cumuliform swarm structure, with rapid ascent and vigorous milling by locusts at considerable height, was observed in association with up-currents recorded as reaching 500 ft. per minute. Earlier in the day, when no such vertical air movements were observed, the structure of the swarm had been stratiform with all locusts flying low. It was found possible to interpret much of the detailed structure of cumuliform swarms in terms of what is known of the structure of convection currents.

Under conditions of vigorous convection, locusts were frequently observed to glide. A series of detailed observations on the strength and distribution of convection currents likely to be encountered by flying locusts was made in Somalia, in a representative area of the East African lowlands. Up-currents probably sufficiently strong to enable gliding locusts to maintain height without muscular effort were found within 100 ft. of the ground, and very much stronger up-currents, frequently reaching 1,000 ft. per minute, were recorded at heights of 1,000–2,000 ft. Still stronger up-currents, well in excess of even the terminal velocity of freely falling locusts with folded wings, are known to occur within cumulo-nimbus clouds, where flying locusts must accordingly be liable occasionally to be forcibly swept up to heights of the order of tens of thousands of feet. Such effects may perhaps help to account for reports of dead adults of *S. gregaria* well above the snow-line on mountains such as Mount Kenya and Kilimanjaro.

It is shown that the development of convection currents from the surface is likely to be much reduced after rain, and all swarms observed in such conditions were stratiform ; it is possible that reduced convective activity after rain may be one of the factors leading to the marked reduction of flying activity recorded during the rains. Conversely, increasing convective activity may be involved in the observed rapid evacuation by swarms of areas that are drying up ; and a marked association of rising sand, dust-storms and similar manifestations of intense convective activity near the ground with notable locust flights may be interpreted as evidence of the role of convection in such movements.

Coaton (W. G. H.). **Toxic-smoke Generators for Termite Control.**—*Fmg in S. Afr.* **22** no. 258 pp. 713–727, 745, 8 figs., 3 refs. Pretoria, 1947.

The value of DDT and BHC (benzene hexachloride) for the eradication of colonies of subterranean wood-destroying termites was investigated in South Africa. In preliminary laboratory tests in 1946, in which workers of *Trinervitermes havilandi* Fuller were confined in petri dishes containing filter paper dusted with 4 per cent. DDT in verdile talc or 1 or 4 per cent. BHC in china clay at a rate equivalent to 10 lb. dust per ½ morgen [a little over one acre], the BHC dusts, which were almost equal in effectiveness, gave complete mortality in 44 hours, whereas the DDT required 69 ; the periods required for complete knockdown were 27 and 1·5 hours for 1 and 4 per cent. BHC, respectively, and 69 hours for DDT. In a field test in which dusts containing 4 per cent. DDT or BHC were applied to nests of *T. havilandi*, which constructs mounds, and the subterranean termite, *Macrotermes natalensis* (Hav.), by means of a hand dust-gun or a pump, however, penetration into the nest system was poor, and, since both materials were extremely repellent, mortality in no case exceeded 10 per cent. of the population. It therefore appeared that adequate coverage and mortality could be obtained only by means of aerosols or toxic smokes applied under pressure, and tests were accordingly made with smokes generated from a mixture of 36 per cent. icing sugar, 12 per cent. sodium chlorate and 52 per cent. toxic ingredient. A tin 5 ins. in diameter contained 1 lb. of the mixture, which was ignited by means of crossed strips of match-head composition in an applicator consisting of a short piece of iron piping, 6 ins. in diameter, fixed to a metal base plate, with an iron lid secured by two steel spring clamps, and a metal funnel sealed into the side, to which was attached a piece of flexible, heat-resisting, metal tubing ending in a nozzle. The generator became exhausted in just over 4 minutes after ignition and produced enough smoke to fill 20,000–30,000 cu. ft. space ; 60–70 per cent. of the toxic ingredient was recoverable from the smoke. In initial tests in which BHC and DDT smokes were applied at a rate of one generator per nest to eight colonies each of *M. natalensis*, *Odontotermes* (*Termes*) *badius* (Hav.) and *O.* (*T.*) *latericius* (Hav.), BHC gave average mortalities after seven days of about 50 per cent. in the case of the first and 25 per cent. in those of the other two, but penetrated only about half way through each nest ; the termites in areas that escaped treatment were unaffected and had walled off the treated parts. Much of the DDT smoke was lost owing to condensation in the cylinder and outlet tube, so that the pressure was reduced, the outlet tube tended to become blocked by the tarry liquid and mortalities were considerably lower than those given by BHC. Work with DDT was therefore discontinued.

An attempt was then made to improve the coverage with BHC by accelerating the rate of production of the smoke and so increasing the pressure under which it was introduced into the nests. A proprietary smoke generator containing about 70 per cent. burning ingredient and 30 per cent. BHC was obtained and 1 lb. of the mixture from it was ignited by means of touchpaper in the cylinder of the applicator previously used. This liberated in 2·5 minutes smoke equal in volume to that previously obtained, and the mortality percentages after seven days in four nests of *M. natalensis* and four of *O. badius* into which it was introduced averaged 90 and 60·4, respectively. The increased speed of generation still did not overcome completely the filtering effect of the nest structures and fungus gardens ; when the dosage of mixture was doubled, however, the speed of generation was increased, and the charge was exhausted in about 1·5 minutes, about 95 per cent. of the smoke being given off in 20–25 seconds. The applicator was unable to withstand the increased pressure, and another, which is described, was accordingly designed. It differed primarily in the method of attachment of the lid, which was secured by means of a screw clamp hinged into two nuts brazed on to the sides of the cylinder. Instructions for its use are given, in which it is stated that it should not be used for passages less than 0·75 in. in diameter or containing loose soil. The screw of the clamp should be lightly oiled, so that if a blockage in the outlet tube or the passage increases the pressure in the applicator, it can turn slightly and permit smoke to escape from under the lid, thus preventing an explosion. BHC smoke derived from 2 lb. of the mixture and applied by means of this equipment to each of 12 nests of *M. natalensis* and 12 of *O. badius* gave complete mortality and complete penetration, even in the diffuse nest of the latter.

The results of a survey of infestation by subterranean termites in Pretoria and the Witwatersrand that is noticed more fully elsewhere [*cf.* next abstract] are reviewed, and methods of locating the nests in buildings are summarised. Those under suspended floors can usually be treated by means of the applicator, but those in earth cores below the slabs of stoeps, floors and hearths are more difficult to treat. Passages passing through the mortar between bricks are not suitable for the introduction of smokes, since they are usually constricted within the walls ; if they must be used, however, a few bricks should be removed to uncover a sufficiently wide passage in the earth core beyond the foundation wall. Extensions of the nest system below the floors of rooms adjoining the one under which the main nest is situated may not always be reached by toxic smokes applied to the latter, owing to constrictions in passages passing through dividing walls, and may need further treatment. One application of the BHC smoke gave complete control in six of seven buildings in Pretoria, and eradication was effected in the seventh after a second treatment.

COATON (W. G. H.). **Infestation of Buildings in South Africa by Sub-terranean Wood-destroying Termites.**—*Bull. Dep. Agric. S. Afr.* no. 299, [4+] 89 pp., 33 figs., 11 refs. Pretoria, 1949.

The following is based largely on the author's summary. Of the 11 species of subterranean termites that have attacked timber in buildings in South Africa, the three Rhinotermitids are of minor importance. They are *Coptotermes formosanus* Shiraki, an introduced termite that caused damage in Simonstown in 1924–27 ; *Psammotermes allocerus* Silv., which is confined to the sparsely settled, desert areas of the west and south-west, but which was found in 1945 infesting most houses in one town, where it caused serious damage to buildings, furniture, paper and cotton fabric and also attacked outdoor timber and trees ; and *Schedorhinotermes lamanianus* (Sjöst.) subsp. *australis* Fuller, which does not readily adapt its habits to conditions in the sub-floor areas of buildings and, though common in the eastern coastal belt, has only twice been recorded damaging structural timbers. These species do not construct surface mounds over their nests and reach timber that is not in contact with the ground only by means of intervening structures ; they cannot be eradicated by toxic smokes, as their subterranean passages are too narrow, but metal termite guards [*R.A.E.*, A **31** 30] in the foundations have afforded adequate protection against them. These characteristics are shared by two Termitids, *Microtermes havilandi* Hlmgr. and *Allodontermes schultzei* (Silv.), which, despite their wide distribution, are of little importance since they rarely adapt themselves to conditions in buildings. The remaining six Termitids are responsible for 99 per cent. of the termite infestation in buildings in Pretoria and the Witwatersrand, where a detailed study was made covering the years 1940–47. All construct mounds or surface structures over their nests, in which there is a central cavity and of which the subterranean passages are wide enough to enable a toxic smoke to be passed through under pressure, and they can reach suspended wood directly from the soil surface. The survey showed that *Macrotermes bellicosus* (Smeath.), *M. swaziae* (Fuller) and *Odontotermes* (*Termes*) *transvaalensis* (Sjöst.) are of minor importance, since they are limited to areas hitherto sparsely inhabited, and that *O.* (*T.*) *badius* (Hav.), *M. natalensis* (Hav.) and *O.* (*T.*) *latericius* (Hav.) are responsible for 87·2, 9·1 and 2·7 per cent., respectively, of the infestation in buildings in Pretoria. Incidence of infestation in Pretoria was very high, and in the Witwatersrand, where it is at least as high, 25·3 per cent. of the buildings were infested and 53·6 per cent. showed evidence of past infestation. Of the nests in buildings, 56·3 per cent. were situated in earth cores, 21·1 per cent. in the air space and 18·5 per cent. in the soil below suspended floors, 3·8 per cent. in the soil outside the building, and 0·2 per cent. in the walls above floor level. In Pretoria, 23 per cent. of the infested buildings had been erected over established colonies and 73 per cent. had become infested by colonisation after erection. Unproofed buildings were subject to periodic and independent infestation, which in one case occurred on an average of once every four years over a period of 20 years.

Specifications for proofing buildings against attack comprise eradication of nests on the site prior to erection, the removal of all scrap cellulose materials from the sub-floor area, structural methods that ensure dry, airy, sub-floor conditions and impenetrable foundation walls and piers, general soil poisoning in the sub-floor area, and the pre-treatment with preservatives of all timbers forming or in contact with the ground floors. None of these measures is satisfactory alone, but collectively they give complete protection owing to their wide overlap in function.

Laboratory experiments, which are described, showed that solutions of 5 per cent. (by weight) pentachlorophenol in furnace oil or sodium pentachlorophenate in water would be satisfactory for use as soil poisons in the sub-floor area, which should be flooded with enough to give minimum soil penetrations of 1 and 2 ins., respectively. An aqueous solution of sodium arsenite was less effective, and one of copper sulphate was of no value. Care should be taken to prevent the disruption of the treated layer. Soil poisoning is the only known method of preventing termites from obtaining direct contact with suspended timbers by means of mound structures, and it has been shown to prevent colonisation of sub-floor areas.

Remedial measures for unproofed buildings that have become infested after erection involve the eradication of the colonies by means of toxic smokes introduced into the nest systems under pressure, the treatment in position of susceptible timbers with penetrative preservative solutions [**36** 415], and general poisoning of the soil and improvement of cross-ventilation below suspended floors. It is pointed out that the protection of standing buildings is costly and that it is difficult to ensure complete proofing since the foundation walls and piers cannot be rendered impenetrable, earth cores cannot readily be poisoned, and the most vulnerable, hidden surfaces of structural timbers are difficult to reach by spray treatments. Two toxic smokes, one of benzene hexachloride produced by igniting a combustible mixture [*cf.* preceding abstract] and one of arsenic and sulphur produced by heating a mixture of white arsenic and sulphur (3 : 1 by weight) on a charcoal fire in a pressure-tight furnace [*cf.* **29** 338], were shown to be entirely satisfactory for eradicating colonies of *Macrotermes* and *Odontotermes*, whether the nests were situated out of doors or in the walls. An applicator by means of which the generated smoke is conducted under pressure into the nest system is described and instructions given for its use [*cf.* preceding abstract].

[Volgin (V. I.).] **Волгин (В. И.). Materials for the Systematics of predacious Mites of the Genus** *Cheyletus* **Latr. (Cheyletidae, Acarina).** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **64** no. 4 pp. 583–586, 1 fig. Moscow, 1949.

Descriptions are given of the adults of both sexes of *Cheyletus polymorphus* and the male of *C. truculentus*, spp.n., which were found preying on unspecified mites infesting stored products at Smolensk (European Russia) and Karagandinsk (central Kazakhstan), respectively. Including these, 11 species of *Cheyletus* are now known from the Palaearctic region, and keys are given to the males of nine of them and the females of six.

[Volgin (V. I.).] **Волгин (В. И.). Materials for the Systematics of Mites of the Genus** *Tyrophagus* **Ouds., 1923 (Tyroglyphidae, Acarina).** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **65** no. 3 pp. 385–388, 1 fig. Moscow, 1949.

Descriptions are given of the adults of both sexes of *Tyrophagus similis* and *T. parvulus*, spp. n., from the Province of Smolensk (European Russia). Those of the first were found in the decaying stem of a plant in a greenhouse, and those of the second in sweepings from the floor and walls of a granary. A key is given to the ten species of *Tyrophagus* now known from the Soviet Union.

MARTIN (Henri). **Observations biologiques et essais de traitements contre la mouche de l'olive** (*Dacus oleae* **Rossi) dans la province de Tarragone (Espagne) de 1946 à 1948.**—*Mitt. schweiz. ent. Ges.* **21** pt. 3 pp. 361–402, 20 figs., 14 refs. Berne, 1948. (With a Summary in German.)

The distribution of *Dacus oleae* (Gmel.) on olive in Spain is limited by climate, since cold damp winters are unfavourable to the pupae in the soil and hot summers to the development of all stages and adult flight. Infestation is therefore highest on the Mediterranean coast and negligible in most of the interior [*cf. R.A.E.*, A **30** 479]. Investigations on the bionomics and control of the Trypetid were carried out in 1946–48 in coastal areas in the Province of Tarragona, where the trees flower at the end of May and the fruits begin to ripen in late October and are harvested in late November and December. Development of the fly was continuous throughout the year, and there were several generations, though the exact number was not determined. Four waves of adult flight occurred in 1947. The larvae that leave the fruits in late autumn or winter pupate in the soil and these gave rise to adults from January onwards, most emerging in January–April. Adults of this generation were present until August. Larvae that become full-fed during summer pupate in the fruits. Further flights of adults were observed in September, October and November, and these probably represented further generations. Infestation at that time of the year was heavy. Laboratory investigations showed that adults did not emerge at temperatures below 7°C. [44·6°F.] and that emergence increased progressively with temperatures up to 20°C. [68°F.]. Adults that emerged at low humidity were unable to spread their wings. Oviposition began in late July, suitable fruits not being available earlier, and continued until late December. Eggs were laid in well developed green fruits, usually at the rate of one per fruit, but not in those that were turning purple, probably because of their high oil content [*cf.* **34** 267]. Attack was very heavy on juicy thin-skinned varieties, and less so on those with thick skins and astringent pulp. Development from egg to adult lasted about a month, and the preoviposition period about two days.

The only parasites observed were *Eupelmus urozonus* Dalm., *Eurytoma rosae* Nees and *Eulophus* (*Pnigalio*) *longulus* (Zett.), which emerged from infested olives in cages and are not specific to *D. oleae.*

In preliminary experiments on control, adults of *D. oleae* were shown to be susceptible to deposits of DDT from acetone solution in petri dishes. A 50 per cent. DDT powder at 0·4 per cent. caused 50 per cent. knockdown in 31 minutes at 20°C. [68°F.], as compared with 17 minutes for *Musca domestica* L. at 25°C. [77°F.]. When an emulsion was compared at 20°C. with a suspension, both at 0·2 per cent. DDT, the times were 9 minutes for the emulsion and 31 for the suspension. There was some evidence, however, that a suitable suspension gave more persistent deposits than emulsions. Further tests were made by releasing adults in cages over sprayed branches. These showed that a suspension containing 0·15 per cent. benzene hexachloride gave poor results and that one of 0·5 per cent. DDT and an emulsion spray of 0·15 per cent. DDT gave complete mortality for nearly two months. The addition of bordeaux mixture had little effect. In a field experiment in 1947, sprays were applied on 16th October and again on 7th–8th November and the olives were gathered in mid-December. The percentages of infestation among harvested and (in brackets) fallen fruits were 6 (51) and 96 (93) for suspensions of 0·5 and 0·25 per cent. DDT, respectively, 20 (56) for an emulsion spray of 0·15 per cent. DDT, and 100 (100) for no treatment. Fallen fruits represented 82 per cent. of the total crop from untreated trees and 12, 31 and 17 per cent. from the others. Although observations on fly abundance indicated that the first application had been made 10–15 days too late and some damage had already occurred, the better of the two suspensions arrested infestation completely. The yield and quality of the oil was improved by treatment, and it is shown that spraying was financially profitable. A further test indicated that bordeaux mixture has no toxicity to the flies but reduces oviposition by rendering the fruits less attractive ; it retards the development of the fruits, however, and toughens their skins.

CLAUSEN (R.-L.). **La lutte chimique contre le hanneton commun.**—*Mitt. schweiz. ent. Ges.* **21** pt. 3 pp. 403–444, 5 figs., 50 refs. Berne, 1948.

A detailed account is given of experiments on the control of adults of *Melolontha melolontha* (L.) on fruit trees in Switzerland by means of sprays of DDT and BHC (benzene hexachloride) and dusts of BHC, the main results of which have already been noticed [*cf. R.A.E.*, A **37** 116]. A dust of 8 per cent. BHC proved about as effective as a 3 per cent. suspension and is considered promising for use in dry weather.

DELUCCHI (V.) & MARTIGNONI (M.). **Primi risultati di uno studio su** *Rhopalosiphoninus latysiphon* **Dav.** [The preliminary Results of a Study of *R. latysiphon.*]—*Mitt. schweiz. ent. Ges.* **21** pt. 3 pp. 453–464, 12 figs., 7 refs. Berne, 1948. (With a Summary in German.)

Following the finding of *Rhopalosiphoninus latysiphon* (Davidson) on stored potato tubers in Switzerland [*cf. R.A.E.*, A **37** 64], investigations on the bionomics of this Aphid were begun at Zürich. The literature on its occurrence in various countries is very briefly summarised, its immature stages are described and diagnostic characters distinguishing the adults are given, with a table showing the relative length of the antennal segments of an apterous parthenogenetic vivipara throughout its development. A colony of the Aphid was set up in the laboratory on sprouting potato tubers in November 1947 and was still maintaining itself normally at the time of writing. Development lasted 12 days at 15–18°C. [59–64·4°F.], both in normal daylight and in the dark, viviparous reproduction began about a day after the last moult, and on an average, each female gave rise to one young Aphid per day, though reproduction was rather more intense in the early part of adult life than later. Very few alates and no sexual forms were produced.

It was found that the Aphids preferred those parts of the sprouts that were tender and poor in chlorophyll. When the tubers were induced to form roots on absorbent paper impregnated with a nutrient solution, immature Aphids in the first two instars migrated from the sprouts to the roots and fed, and when five adults were introduced to a depth of 4 ins. into soil near the roots of potato, 12 Aphids (including immature individuals) were recovered after a fortnight ; Aphids in similar conditions but without food died in 12 hours. Five adults transferred to young potato plants in cages avoided the green parts of the plants and preferred those poor in chlorophyll. Colonies became established on *Chrysanthemum* spp. both indoors and in the open, but not on *Vinca minor*, though the Aphid was originally described from *V. major* in California. Although the Aphid occurred on stored potatoes harvested near Zürich, it could not be found on any of its recorded food-plants growing in the vicinity.

In experiments on the effect of temperature, colonies of the Aphid developed normally at 10°C. [50°F.], survived for a week at 26°C. [78·8°F.] and died in 24 hours at 33°C. [91·4°F.], even when humidity was high. The optimum for development appeared to be 15–18°C. combined with normal humidity. Attempts to increase the production of alates by various means gave inconsistent results, but it was observed that crowded conditions on the potato sprouts increased their numbers.

ZOGG (H.), HORBER (E.) & SALZMANN (R.). **Bericht über die Tätigkeit der Eidg. Landwirtschaftlichen Versuchsanstalt Zürich-Oerlikon pro 1947/48. 8. Pflanzenschutz.** [Report of the Federal Agricultural Experiment Station Zürich-Oerlikon for 1947–48. 8. Plant Protection.]—*Landw. Jb. Schweiz* **63** pt. 4 pp. 383–395, 2 figs. Berne, 1949.

Notes are given as for previous periods [*cf. R.A.E.*, A **39** 68, etc.] on pests and diseases of various crops in Switzerland in the calendar year 1948. Pests that were more than usually injurious in the field included the mite, *Tarsonemus spirifex* Marchal, on rye and barley, *Pyrausta nubilalis* (Hb.) on maize (in the Ticino), and *Cnephasia* (*Tortrix*) *wahlbomiana* (L.) on peas. Stored potatoes were commonly infested by the Aphids, *Macrosiphum solani* (Kalt.) (*Aulacorthum pseudosolani* (Theo.)) and *Rhopalosiphoninus latysiphon* (Davidson) [*cf.* **37** 64], and *Bruchus obtectus* Say (*Acanthoscelides obsoletus*, auct.) was so numerous on stored beans that field infestation north of the Alps in the previous summer, which was unusually warm, was suspected. Parasites observed for the first time in Switzerland comprised the Pteromalid, *Callitula bicolor* Spin., in pupae of *Chlorops* (*Oscinis*) *pumilionis* (Bjerk.), the Braconid, *Opius* (*Biosteres*) *wesmaeli* Hal., in pupae of *Pegomyia hyoscyami* (Panz.), which was common in many places on beet, and the Ichneumonid, *Angitia punctoria* Roman, in maize stalks heavily infested by *Pyrausta nubilalis*. *Hemiteles tenuipes* (Grav.) also emerged from the maize stalks, in which it may have parasitised *A. punctoria*. There was no significant increase in the distribution of *Leptinotarsa decemlineata* (Say) on potato. In tests of insecticides against it [*cf.* **39** 68], treatment with DDT suspensions or dust or a chlordan emulsion gave better control than a spray of 8 per cent. calcium arsenate and afforded good protection against feeding. Emulsion sprays and a dust of parathion gave inconclusive results against *L. decemlineata*, but considerably reduced the numbers of Aphids (*Aphis* (*Doralis*) *rhamni* Boy., *Myzus persicae* (Sulz.) and *Macrosiphum solanifolii* (Ashm.)) on the plants. Populations of Aphids were high following treatment with DDT or calcium arsenate.

In work on the control of *Melolontha*, a light-trap containing a mercury-vapour lamp failed on three consecutive evenings to attract flying adults. Newly-hatched larvae were only one-twelfth as numerous in the autumn of 1948 in soil that had been treated with BHC (benzene hexachloride) against third-year larvae in 1947 [**39** 68] as in untreated ground. A proprietary BHC preparation applied in liquid manure in the autumn caused a significant reduction in 41 days in the number of first-year larvae in grassland, but the milk from cows fed on grass from the treated area was tainted. On rape, dusts of DDT alone or with parathion, and also a chlordan emulsion, were more effective than a BHC suspension against *Meligethes aeneus* (F.), but only BHC proved effective against *Ceuthorrhynchus napi* Gylh. and *C. quadridens* (Panz.).

MAYNÉ (R.) & BRENY (R.). **Contribution à l'étude des circonstances climatiques influençant le pouvoir d'éclosion des oeufs de** *Picromerus bidens* **L.**—*Parasitica* **3** no. 4 pp. 133–141. Gembloux, 1947. *Picromerus bidens* **L. La vie larvaire au premier âge.**—*Op. cit.* **4** no. 1 pp. 1–20, 4 figs., 7 refs. 1948. (With Summaries in Flemish, English and German.)

The investigations described in these papers were carried out in Belgium with a view to the utilisation there of the predacious Pentatomid, *Picromerus bidens* (L.), against larvae of *Leptinotarsa decemlineata* (Say) on potato [*cf. R.A.E.*, A **34** 213]. The first comprises an account of experiments on the effect of temperature on eggs of the Pentatomid kept in the laboratory and out of doors, from which the following conclusions are drawn. Exposure to low temperatures is necessary for hatching, and the percentage hatch increases with the duration of this exposure for periods of up to a month or more. The effect of low temperature varies among eggs from different females and probably among eggs within one mass, but satisfactory hatching was obtained after exposure for 36 days to a constant temperature of −1·5°C. [29·3°F.]. For eggs kept at fluctuating temperatures with a minimum of 0·5°C. [32·9°F.], the range of fluctuation was an important factor influencing hatching, which was satisfactory following exposure to a mean daily fluctuation of 14·2°C. [25·56°F.] for two months, but not to one of 5°C. [9°F.] for six months.

The second paper contains a description of the first-instar nymph and an account of observations on the factors that influence its development. No food is taken at first, and later only water or plant sap, in the absence of which the nymphs die, even in a moist atmosphere. The threshold of development was slightly below 15°C. [59°F.], and the optimum about 30°C. [86°F.], at which the instar was completed in 2–3 days.

BERNARD (J.). **Communication sur la présence d'*Hoplocampa brevis* sur poirier dans la région de Malines.**—*Parasitica* **3** no. 4 pp. 142–143. Gembloux, 1947.

Hoplocampa minuta (Christ), *H. testudinea* (Klug), *H. brevis* (Klug) and *H. flava* (L.), which attack plum, apple, pear, and plum and cherry, respectively, all occur in Belgium, but have usually been considered rare. On several occasions between 1934 and 1946, however, the first three were reported as injurious in various localities, and *H. brevis* was sufficiently numerous on pear at Malines at the beginning of May 1947 to necessitate the application of control measures.

ANDERSEN (V. S.). **Untersuchungen über die Biologie und Bekämpfung der Obstbaumspinnmilbe** *Paratetranychus pilosus* **Can. et Fanz.** [Investigations on the Biology and Control of *P. pilosus*.]—*Inaug.-Diss. landw. Fak. rhein. Friedr.-Wilh.-Univ. Bonn* v+118 [+1] pp., 24 figs. (4 col.), 54 refs. Bonn, Inst. Pflkrankh., 1947. (With Summaries in Danish and English.)

The following is based largely on the author's summary. In view of the increasing importance of *Paratetranychus pilosus* (C. & F.) as a pest of fruit trees in Germany, investigations on its bionomics and control were carried out near Cologne in 1943–46. The nomenclature, distribution, food-plants and economic importance of the mite are discussed, and all stages are described.

Five generations were produced between the end of April, when the winter eggs hatched, and the end of November, but there was considerable overlapping of the later ones. The overwintered and first generations deposited summer eggs only, the second and third both summer and winter eggs, and the fourth winter eggs only. Oviposition began 3–5 days after emergence, was favoured by dry warm weather, and decreased by rain. The total numbers of eggs laid per female averaged 27, 16 and 14 for the first three generations, respectively, and the daily averages were 2·1, 1·3 and 1. The maximum number of eggs per day (5) and the maximum total number (45) were laid by females of the overwintered generation. The development of the summer eggs lasted for an average of 15·4 days, with a maximum of 21, requiring 6 days at 70°F., 10–11 days at 63°F. and 16–18 days at 55°F. The deposition of winter eggs continued from late August until the onset of cold weather in October or November, ceasing at temperatures below 46°F. Parthenogenetic reproduction occurred, unfertilised females giving rise to males only, but it is thought to be rare. The winter eggs hatched from the middle or end of April, when plums and damsons were in blossom and just before the flowering of apple. The duration of development from egg to adult averaged 14·3 days for females and 13·2 days for males. It lasted only 7 days at 70°F., as compared with 18 days in spring and 23 days in autumn. Relative humidities below 40–50 per cent. had no detrimental effect on development, but rain, especially if accompanied by low temperatures, delayed it and increased mortality. Adult males and females survived for averages of 10·4 and 16·2 days in summer and longer in spring and autumn. Though oviposition ceased and activity was markedly reduced at about 8°C. [46·4°F.], the adults withstood a temperature of −7·2°C. [19°F.], and their disappearance in autumn was due to lack of food rather than to cold. Spread was effected by migration of the adult females within a tree and by wind over short distances. Infestation is also spread with nursery stock. Abundance depends primarily on favourable weather in spring, and the period from the hatching of winter eggs to the deposition of the first summer eggs is critical for the building up of the population.

The most important natural enemies observed were *Anthocoris nemorum* (L.), *Orius minutus* (L.) and *Stethorus* (*Scymnus*) *punctillum* Weise. Since these predators did not appear in numbers until mid-July, however, when considerable damage had already occurred, they did not afford appreciable control. Their value is still further reduced by the use of acaricides that are toxic to them.

In experiments on control of the winter eggs, a miscible oil (97 per cent. actual oil) at 2–6 per cent. and tar distillates of the heavy- and medium-oil types at 5 per cent. gave complete mortality in the laboratory, a proprietary paste containing 25 per cent. dinitro-o-cresol (DNC) as the mixed potassium and sodium salts at 1 and 2 per cent. was less effective, and lime-sulphur (20° Bé) and Solbar (barium polysulphide) at 15 and 5 per cent., respectively, at which concentrations they each contained about 1·5 per cent. polysulphide sulphur, were poor. In field tests, the miscible oil proved less effective and the DNC product failed completely, which was shown to be due to the influence of temperature and humidity, the effectiveness of the oil increasing with temperature almost irrespective of humidity and that of DNC increasing with temperature at high humidity but not at low. At constant temperature, the effectiveness of DNC rose rapidly with humidity, and that of the oil much less sharply. When the various sprays were applied to damson and apple in the field on 18th March or on 11th April, the miscible oil at 5–6 per cent. gave by far the best results, and mortality was higher following the later spraying, probably owing to the warmer weather. Lime-sulphur, barium polysulphide, DNC and the tar distillate of the medium-oil type were ineffective, and the last two scorched the leaves and flower buds at the later date of application. The tar distillate of the heavy-oil type was tested only on 19th February, when it was nearly as effective as the miscible oil.

In experiments with summer sprays, 2 per cent. lime-sulphur, 1 per cent. barium polysulphide and 0·5 per cent. mineral oil all gave good control and were as effective as dormant sprays. Lime-sulphur did not kill the eggs and barium polysulphide killed only a few, but the residues from both were toxic to the newly hatched mites. In further tests, barium polysulphide proved more effective and more persistent than a nicotine preparation or E605f [parathion], but the last was of considerable value on peach, which is injured by mineral oil or polysulphide preparations. Treatment should be applied before the summer eggs are laid. If carried out later, it should be repeated after 10–14 days.

From the investigations described, the author concludes that, as even 98 per cent. mortality of the winter eggs does not obviate the necessity of spraying during the vegetation period, and as the dormant oil sprays require supplementing with tar distillate or dinitro-o-cresol against the eggs of *Psylla mali* (Schm.) or Aphids, the control of *P. pilosus* should chiefly be effected by means of polysulphide preparations in summer, particularly as these also act as fungicides, the first application to be made immediately after petal-fall.

UHER (M.). **Červec San José na Slovensku.** [The San José Scale in Slovenia.]—*Ochr. Rost.* **21** pt. 1–2 pp. 37–40. Prague, 1948.

Infestation of fruit trees by the San José scale [*Quadraspidiotus perniciosus* (Comst.)] in the district of Bratislava, Czechoslovakia, is extremely heavy. It was favoured by the weather in 1947–48, when the third generation became particularly numerous. Sprays of oil emulsion containing up to 20 per cent. actual oil proved insufficient for control, and even 20 per cent. Neodendrin [a tar-distillate preparation] was unsatisfactory when the scales occurred in layers. Undiluted petroleum oil gave complete mortality, but scorched 40 per cent. of the leaves. Details are given of a projected campaign against the Coccid, in which sprays of oil or Neodendrin were to be employed.

BÖHM (H.). **Sommerbekämpfung der San José-Schildlaus** (*Quadraspidiotus* (*Aspidiotus*) *perniciosus* **Comst.**). [Summer Spraying against *Q. perniciosus*.]—*Pflanzenschutzberichte* **3** pt. 1–2 pp. 1–9, 7 refs. Vienna, 1949. (With a Summary in English.)

Although winter sprays of oil emulsion or lime-sulphur are effective against *Quadraspidiotus perniciosus* (Comst.) on fruit trees, it is sometimes desirable to apply treatment in summer, and for this purpose several modern insecticides were compared with nicotine and lime-sulphur in the laboratory and in the field near Vienna in 1948. In the field experiments, apple and pear trees were treated 1–3 times between May and September, and mortality percentages were calculated according to Abbott's formula [*R.A.E.*, A **13** 331]. They were 30–38 for a spray of 0·2 per cent. nicotine, 36–53 for 2 per cent. lime-sulphur containing 25 gm. polysulphide sulphur per 100 cc., 67–90 for an emulsion spray containing 0·2 per cent. DDT (which was more effective than a 10 per cent. DDT dust or a 0·5 per cent. DDT suspension), 67–78 for a dust of 3·5 per cent. benzene hexachloride, and 97–100 and 98–100 for sprays containing 0·035 and 0·056 per cent. parathion. Comparable results were obtained in laboratory experiments in which infested apple and *Ribes* shoots were dusted or immersed for five seconds in the various materials. When females isolated by the technique described by Beran [**31** 49] were treated by means of a brush with various materials, the mortality percentages were 100 and 90 for 0·035 and 0·021 per cent. parathion, respectively, with few nymphs produced by the surviving adults, and 0 for lime-sulphur, nicotine, and DDT, though lime-sulphur reduced the numbers of crawlers that settled [*cf.* **38** 264]. The numbers of living and (in brackets) dead crawlers per sq. cm. of bark scraped and sprayed 14 days previously were 4 (1), 5 (10) and 3 (11) for lime-sulphur and 0·035 and 0·056 per cent. parathion, as compared with 31 (0), 28 (0) and 29 (1), respectively, for no treatment, and the other materials again gave inferior results.

BERAN (F.). **Auftreten und Bekämpfung des Kartoffelkäfers in Österreich im Jahre 1948.** [The Occurrence and Control of the Potato Beetle in Austria in 1948.]—*Pflanzenschutzberichte* **3** pt. 1–2 pp. 17–25, 1 map, 3 refs. Vienna, 1949.

Surveys carried out in Austria in 1948 showed that the potato beetle [*Leptinotarsa decemlineata* (Say)] had increased its distribution only slightly on potato in the provinces in which it had been observed in 1947 [*R.A.E.*, A **38** 163, etc.], but a new and severe outbreak presumably originating from Jugoslavia was reported from the south-east of the province of Styria, near the frontier. The history and organisation of the campaign against the beetle in Austria are described, and records are given of the numbers of the various stages collected in infested localities in 1948. The usual control measures [**38** 163] were applied in outbreak areas.

JAHN (E.). **Die Polyederkrankheit des grauen Lärchenwicklers** *Grapholitha (Semasia) diniana.* [Polyhedral Disease of *Enarmonia diniana.*]—*Pflanzenschutzberichte* **3** pt. 3–4 pp. 33–41, 5 figs., 10 refs. Vienna, 1949. (With a Summary in English.)

One of the factors that led to the collapse of the outbreak of *Enarmonia* (*Grapholitha*) *diniana* (Gn.) on larch in the Tyrol in 1948 was polyhedral disease among the larvae [*cf. R.A.E.*, A **39** 365]. In this paper, the author gives an account of investigations that demonstrated the presence of polyhedra in the fluid from larvae killed by the disease and describes the appearance of the various bodies observed.

PRIMOST (E.). **Schädigungen von gärtnerischen Kulturpflanzen bei Anwendung von DDT als Bodendesinfektionsmittel. (Vorläufige Mitteilung.)** [Damage caused to Garden Plants by DDT used as a Soil Insecticide. (Preliminary Communication.)]—*Pflanzenschutzberichte* **3** pt. 3–4 pp. 42–47, 3 figs., 10 refs. Vienna, 1949. (With a Summary in English.)

Tomato and bean plants grown in pots in soil mixed with 0·01–0·05 per cent. DDT showed a less well-developed root system, and were smaller and produced fewer flowers than those grown in untreated soil [*cf. R.A.E.*, A **34** 176].

BLATTNÝ (C.) & OSVALD (V.). **Příspěvky k prognostice škodlivých činitelů chmele : III. Sviluška chmelová** (*Epitetranychus altheae* **v. Hanst.**). [Contributions to the Prognosis of Factors injurious to Hops. III. The Hop Red Spider (*Tetranychus telarius* L.).]—*Ochr. Rost.* **21** pt. 3–4 pp. 5–13. Prague, 1948. (With a Summary in French.)

Tetranychus telarius (L.) (*Epitetranychus althaeae* v. Hanst.) is one of the most important pests of hops in Czechoslovakia, but its abundance depends on climatic conditions and the activity of its natural enemies. The mite is favoured by warm dry weather, oviposition beginning at a mean of 12°C. [53·6°F.], and the egg stage lasts six days at that temperature and three at 18°C. [64·4°F.]. The mites cease feeding when the relative humidity reaches 80 per cent. and do not reproduce at 90 per cent. The natural enemies, in order of decreasing importance, are *Stethorus punctillum* Weise, *Orius* sp., *Oligota granaria* Erichs. and *Thrips flavus* Schr. [*cf. R.A.E.*, A **37** 3].

S. punctillum completes its development in 30–45 days, and 1–3 generations occur according to the weather. The adults hibernate, and the females lay a total of 50–100 eggs each over a period of six weeks, so that all stages are present simultaneously. Both larvae and adults destroy large numbers of all stages of the mite. From their observations, the authors suggest that it may prove possible to forecast outbreaks of *T. telarius* by consideration of weather and the abundance of natural enemies.

In view of the importance of *S. punctillum*, its distribution to hop-growing districts in which it was insufficiently numerous was begun in the autumn of 1947. In connection with spring releases, a winter generation was reared in the greenhouse and it is suggested that adults hibernating on dry hop vines in sheds and barns should be collected and liberated in hop gardens in spring.

MOORE (M. H.). **Nut Rotting in** *Corylus avellana* **L. in Relation to the Activities of the Nut Weevil,** *Balaninus nucum* **L.**—*J. hort.Sci.* **25** no. 4 pp. 213–224, 2 pls., 15 refs. London, 1950.

The following is based on the author's summary. Rotting and premature dropping of cob-nuts and filberts, first recorded in Britain in 1944, result in severe loss of crop in commercial plantations. The rot was shown by experiments to be chiefly due to wound-parasitism by *Sclerotinia* (*Monilia*) *fructigena* in oviposition punctures made by *Curculio* (*Balaninus*) *nucum* L. in the soft-shelled nuts early in July. Certain other wound-parasites, such as *Botrytis cinerea* and *Fusarium lateritium*, caused minor injury. Protective applications of fungicides were not effective against the pathogen, but the use of lead-arsenate sprays resulted in some reduction in rotting by controlling the weevil, and the later the spray was applied before nut-dropping began, the better the result.

MOORE (M. H.). **Brown Rot of Apples : Fungicide Trials, and Studies of the relative Importance of different Wound-agents.**—*J. hort. Sci.* **25** no. 4 pp. 225–234, 1 pl., 14 refs. London, 1950.

The author describes experiments in Britain in which organic fungicides, applied as protective sprays, showed no promise of controlling brown rot of apples (*Sclerotinia* (*Monilia*) *fructigena*). The fungus gains entry by means of wound-parasitism [*cf. R.A.E.*, A **34** 370], and experiments were made in 1946–48 to determine the relative importance of avoidable wound-producing agents as precursors of infection. Different plots received a complete spray programme, one that was complete but for the omission of lead-arsenate sprays against *Cydia pomonella* (L.), one complete but for the omission of a spray of nicotine and a wetting agent against *Hoplocampa testudinea* (Klug) and one complete but for the omission of lime-sulphur sprays against apple scab (*Venturia inaequalis*). The trees were examined at weekly intervals. The results for three seasons showed averages of 9·1, 21·2, 7·3 and 19·5 per cent. infected fruits for the four schedules, respectively, and it is concluded that *C. pomonella* and *V. inaequalis* were the principal precursors of brown rot, that *H. testudinea* was unimportant, and that mechanical injuries were on the whole only a minor factor. Routine applications of tar distillate had been made in winter on all trees against Aphids and apple sucker [*Psylla mali* (Schm.)], and it is possible that attack by insects that were controlled by these and by the inclusion of lead arsenate in the green-cluster spray may also be important at times.

WOOD (C. A.). **The Strawberry Aphid,** *Pentatrichopus fragariae* **(Theob.), in North Wales, with special Reference to the Maintenance of healthy Strawberry Stocks in non-fruit-growing Areas.**—*J. hort. Sci.* **26** no. 1 pp. 22–34, 4 figs., 16 refs. London, 1950.

The following is based on the author's introduction and summary. The survey of populations of *Capitophorus* (*Pentatrichopus*) *fragariae* (Theo.), which transmits virus diseases of strawberry in North Wales, was extended in 1940–45 from Denbighshire [*cf. R.A.E.*, A **29** 27] to the western counties of Anglesey and Caernarvon, where climatic factors reduce migration of the potato-virus vector, *Myzus persicae* (Sulz.), and were thought likely to affect *C. fragariae* similarly.

The Aphid was extremely scarce in 1940 and 1941, after severe winters, but abundant in 1943, after a mild one, and in 1944, but scarce again in 1945. Plantings of strawberry of the variety Huxley Giant bore larger populations of *C. fragariae* than did comparable plantings of other varieties, and larger populations occurred on young than on older plantings of Huxley Giant. Although the Aphids were frequently infected by the fungus, *Empusa planchoniana*, this did not develop early enough to prevent widespread spring migration by the alates. These migrations, in 1938, 1943 and 1944, caused a serious spread of virus infection, alates being plentiful for at least six weeks, mainly in late May and June, and an examination of meteorological data indicated that such migration is likely to occur in the lower Dee Valley in almost any year in which Aphid populations are large.

Experimental plots in districts of Caernarvon and Anglesey in which strawberries are not grown commercially remained free from *C. fragariae* in 1940–42, but five of nine plots were colonised after migration in 1943, and it is concluded that if strawberry-growing were extended to these districts, the usual measures against Aphids would be necessary.

PRENTICE (I. W.) & WOOLLCOMBE (T. M.). **Resolution of Strawberry Virus Complexes. IV. The latent Period of Virus 3 in the Vector.**—*Ann. appl. Biol.* **38** no. 2 pp. 389–394, 6 refs. London, 1951.

The following is virtually the authors' summary of the investigations described in this part of a series [*cf. R.A.E.*, A **37** 483], in which the test plants were wild strawberry (*Fragaria vesca*). From the time of first feeding on plants infected with strawberry virus 3, 10–19 days elapsed before apterae of *Capitophorus fragariae* (Theo.) became infective, a longer latent period than any previously recorded for an Aphid-transmitted virus. The time taken for Aphids to develop infectivity after leaving infected plants decreased with increasing duration of the infection feed. Aphids that had fed for 16 days on an infected plant caused infection in the first day of test feeding. The virus was also transmitted by Aphids that developed wings.

BROADBENT (L.) & TINSLEY (T. W.). **Experiments on the Colonization of Potato Plants by apterous and by alate Aphids in Relation to the Spread of Virus Diseases.**—*Ann. appl. Biol.* **38** no. 2 pp. 411–424, 3 figs., 9 refs. London, 1951.

The following is almost entirely the authors' summary. Experiments in which batches of potato plants in pots were placed in the field for limited periods among plants infected with potato virus Y and leaf-roll were carried out in southern England in 1947–49 to determine the relative importance of apterous and alate Aphids as vectors of viruses within a crop [*cf. R.A.E.*, A **38** 295, etc.]. *Myzus persicae* (Sulz.) was the principal species present. Some of the potted plants were surrounded by sticky boards, which prevented apterous Aphids from reaching them. Almost as many plants within the boards as without became infected, indicating that most of the spread of virus was by winged Aphids. Apterae were probably responsible for spreading the viruses throughout a hill after one or more stems were infected. They may carry infection to neighbouring plants, but most of these will have been infected already by alates. The number of plants contracting infection was unaffected by watering.

MILES (M.). **Factors affecting the Behaviour and Activity of the Cabbage Root Fly** (*Erioischia brassicae* **Bché**).—*Ann. appl. Biol.* **38** no. 2 pp. 425–432, 1 graph, 8 refs. London, 1951.

The following is substantially the author's summary of the observations described, which were carried out in the laboratory and on cruciferous crops in south-eastern England in 1948–50 [*cf. R.A.E.*, A **38** 379]. The behaviour of adults of *Hylemyia* (*Erioischia*) *brassicae* (Bch.) is governed by their need for food and shelter. Captive flies given sugar solution lived for up to 62 days, and a laboratory-reared female laid 122 eggs. Weather conditions determine the activity and the length of life of the flies. Feeding and egg-laying occur in warm sunny weather, and long periods of sunshine with temperatures of at least 60°F. in the latter half of April are associated with the onset of attack on the food-plants. In cold or wet weather, the flies shelter in soil or in thick herbage, and if they are immobilised for some time they die of starvation. In this way, the onset of cold weather checks the development of attack. Details are given showing the effect of weather on the activity of the flies in the springs of 1948–50. Eggs are laid in batches of varying size at irregular intervals during about a month. The position of the eggs about the food-plants is affected by weather. They are usually laid in the soil, but when the pressure of sunshine and drought is removed, they are laid freely on aerial parts of the plants. Knowledge of the influence of the weather on the activity of the flies enables attack to be anticipated with some degree of accuracy and control measures to be carefully timed.

Dunn (E.). **Wing Coloration as a Means of determining the Age of the Colorado Beetle** (*Leptinotarsa decemlineata* **Say).**—*Ann. appl. Biol.* **38** no. 2 pp. 433–434, 1 col. pl., 2 refs. London, 1951.

The age of first-generation adults of *Leptinotarsa decemlineata* (Say) can be determined for at least 20–23 days after emergence by means of the colour of the membranous hind wings. On emergence, the wing is practically colourless, but it gradually develops a red patch, which, by the end of three weeks, extends over the basal area and into the apical and anal regions. These changes are illustrated on a coloured plate.

Lord (K. A.) & Potter (C.). **Studies on the Mechanism of insecticidal Action of organo-phosphorus Compounds with particular Reference to their anti-esterase Activity.**—*Ann. appl. Biol.* **38** no. 2 pp. 495–507, 1 graph, 12 refs. London, 1951.

Previous work has indicated that the toxicity to insects of parathion, TEPP (tetraethyl pyrophosphate) and HETP (hexaethyl tetraphosphate) of which TEPP is the principal insecticidally active constituent, is due to their inhibition of cholinesterases [*cf. R.A.E.*, A **38** 312 ; **39** 307–308, etc.], and an account is given of further studies on the anti-esterase activity of these compounds. The following is based on the authors' summary. An esterase extract prepared from larvae of *Tenebrio molitor* L. by a method that is described hydrolysed ethyl butyrate and o-nitrophenyl acetate, but not acetylcholine, and was inhibited by TEPP-containing materials and parathion. An enzyme that hydrolyses o-nitrophenyl acetate and was inhibited by a TEPP-containing material (HETP) was also demonstrated in eggs and larvae of *Diataraxia oleracea* (L.), eggs of *Ephestia kuehniella* Zell., larvae of *Plutella maculipennis* (Curt.), and *Macrosiphum solanifolii* (Ashm.) (*euphorbiae* auct.) and *M. onobrychis* (Boy.) (*Acyrthosiphon pisi* (Kalt.)).

The relative toxicities as contact sprays to adults of *Tribolium castaneum* (Hbst.) of ten samples of materials containing TEPP were compared with their relative activities as esterase inhibitors. There was not an exact quantitative correlation between TEPP content estimated chemically, toxicity and anti-esterase activity, but the correlation was sufficient to suggest interdependence of these factors.

The enzyme in the eggs of *D. oleracea* and *E. kuehniella* was already present in them when they were less than 24 hours old and showed no visible sign of development. TEPP was shown to be toxic to these eggs, and at high concentrations it killed them at an early stage of development before differentiation of the nervous system. This, in conjunction with the other evidence, suggests that esterases other than the cholinesterase of the nervous system are important when considering the toxic action of these compounds.

Comparisons of the anti-esterase activity and toxicity of parathion and TEPP-containing materials as contact insecticides showed that although the TEPP materials were the more potent enzyme inhibitors, parathion was the more potent contact insecticide to five species of insects. This appears to be due to the relative instability of TEPP. A study of the rates of action of the two poisons applied at different concentrations supported this view.

DAVID (W. A. L.). **Insecticidal-action Studies with Bisdimethylaminophosphonous Anhydride containing ^{32}Phosphorus.**—*Ann. appl. Biol.* **38** no. 2 pp. 508–524, 13 refs. London, 1951.

Methods of observing the uptake and translocation of the systemic insecticide schradan (bisdimethylaminophosphonous anhydride) in plants have so far been limited to observing its insecticidal action when so translocated. Since this is unsatisfactory when the sensitivity of the insect to the poison or the capacity of the plant to absorb and translocate it is unknown, investigations were made with radioactive schradan containing P^{32} [*cf. R.A.E.*, A **39** 376].

The following is substantially the author's summary of the results. The radioactive anhydride was absorbed by the roots of broad-bean plants placed in culture solutions containing it. The level of radioactivity in the plant increased as the solution was absorbed and was higher in the washed roots than in the rest of the plant. The activity of the remaining culture solution increased as more was absorbed, showing that the roots selectively reject the radioactive anhydride. The material was absorbed more slowly from soil than from sand. In both cases, the concentration per gram of tissue was highest in the leaves on the middle part of the stem. By introducing the insecticide by the cut tap-root technique [**39** 200], it was shown that about 50 per cent. of the anhydride is decomposed within the plant in eight days [*cf.* **39** 376]. The concentration of undecomposed anhydride in the plant necessary to give a complete kill of *Aphis fabae* Scop. was found to be about 50 mg. per kg. plant tissue. Dead Aphids were found to contain about 15–20 mg. per kg. radioactive material calculated on the assumption that it was undecomposed anhydride. The honey-dew of Aphids feeding on treated plants was also radioactive.

Absorption and translocation of the radioactive material occurred following application to the leaves of broad bean, cabbage, hop, pea and strawberry. In broad bean, radioactive material was detected within the leaf a few hours after it had been applied to the surface. In all plants, there was evidence that radioactive material is translocated to untreated parts. Much more was translocated to leaves younger than those treated than to leaves older than those treated. In favourable cases, where a large number of leaves on the plant were treated, where the plant held a large quantity of the anhydride applied, or where a heavy dose was given, either by repeated treatments or by the use of high concentrations, insecticidal quantities of what was presumed to be the anhydride were translocated to untreated young growing parts of the plants. No measurable quantity of radioactive material was transpired by plants taking up the material through the roots.

Proceedings of the IInd International Congress of Crop Protection, London 20th–31st July, 1949.—viii+521 pp., illus., many refs. London, 1951.

Of the 82 papers read at this conference, about half are concerned with materials, mainly synthetic organic compounds, used for the control of insects or mites and together provide a survey of work recently completed or in progress on their chemistry, toxicity, action and value.

BALACHOWSKY (A. S.). **La lutte contre les insectes. Principes—méthodes—applications.**—380 pp., 8 pls., 57 figs., many refs. Paris, Payot, 1951. Price *Fr.* 1000.

This comprehensive review of the ways in which insect pests can be controlled deals primarily with pests of plants and stored products and is based largely on the literature up to 1950. The historical development of insect control is summarised, and six chapters deal in detail with the various methods now available. The one on chemical control occupies rather more than a quarter of the book and includes a section concerned with the fundamental requirements of insecticides, synergism, the development of resistance in pests and harmful effects on beneficial insects, and others containing information on the chemical and physical properties, preparation, mode of action and method of use of various insecticides, including recently developed synthetic organic materials. The chapter on biological control is of comparable length and comprises a review of the different methods whereby insects, fungi, bacteria and viruses have been employed in insect control in various parts of the world, with a systematic review of the groups of insects that include parasitic or predacious species and some examples of the use of other animals in controlling insects. Cultural and mechanical methods and measures that depend on behaviour responses, such as the use of light traps, baits and repellents, or that utilise heat, cold and other physical factors are dealt with in less detail. A short account of the ways in which insects have been used for the control of noxious weeds in different parts of the world is included.

WADE (J. S.). **A selected Bibliography of the Insects of the World associated with Sugar Cane, their Predators and Parasites.**—*Mem. int. Soc. Sug. Cane Tech.* no. 1, [2+]113 pp. Honolulu, 1951.

This bibliography is based on literature published in different countries chiefly during 1919–39. It is preceded by a numbered alphabetical list of 1,277 species of insects and a few other organisms associated with sugar-cane, with indication of the 315 that are parasites or predators, the authors and dates of papers dealing with them, and their distribution, and cross references to hosts and parasites or predators.

KAPUR (A. P.). **The Identity of some Crambinae associated with Sugar-cane in India and of certain Species related to them (Lepidoptera : Pyralidae).**—*Trans. R. ent. Soc. Lond.* **101** pt. 11 pp. 389–434[+2], 10 pls., 88 refs. London, 1950.

Descriptions are given of 27 species of Crambine moths most of which occur in India, with records of their distribution and, if known, their food-plants. Their larvae usually infest graminaceous plants, and some of them are pests of sugar-cane in India or elsewhere. They belong to the genera *Chilo*, *Coniesta*, *Proceras*, *Stenochilo*, *Bissetia*, *Chilotraea*, *Drasa* and *Girdharia*, of which the last four are new. *Chilotraea* is erected for four species, of which one is new and the others were first described in *Chilo*. The type is *Chilotraea infuscatella* (Sn.), which attacks sugar-cane in India and Formosa and is also recorded from Korea, Java and Burma. *Bissetia*, *Drasa* and *Girdharia* are monotypic, the species being *Bissetia* (*Chilo*) *steniella* (Hmps.), which bores in sugar-cane in India and is also recorded from Indo-China, *Drasa* (*Diatraea*) *cashmirensis* (Hmps.), the biology of which is unknown, and *Girdharia tauromma*, sp. n., which attacks *Saccharum spontaneum* in India, where it has been confused with the Australian *Crambus* (*Chilo*) *torrentellus* Meyr. [*R.A.E.*, A **9** 211], and is also recorded from Indo-China. The other new species include *Proceras indicus*, which is the borer hitherto recorded on sugar-cane in India as *P. venosatus* (Wlk.) ; the latter is recorded from Formosa, China, North Borneo and Malaya and is a pest of sugar-cane in the first two. Other changes in generic assignment or synonymy that affect species that have been mentioned in this *Review* include *Chilo* (*Argyria*) *tumidicostalis* (Hmps.), *C. suppressalis* (Wlk.) (*simplex* (Btlr.)), *Chilotraea* (*Chilo*) *auricilia* (Dudgn.), *Chilotraea* *infuscatella* (*Argyria sticticraspis* Hmps., *Diatraea shariinensis* Eguchi [**22** 57]), and *Bissetia steniella* (*Chilo trypetes* Bisset [**27** 456]).

Box (H. E.). **Observations on the Sugar-cane Moth Borer,** *Diatraea saccharalis* (**Fabr.**) **in Peru.**—*Proc. 7th Congr. int. Soc. Sug. Cane Tech. 1950* pp. 328–343, 6 figs., 1 map, 14 refs. Brisbane, 1951. Also as **El barreno de la caña de azúcar. Observaciones sobre el " borer " o barreno de la caña de azúcar** (*Diatraea saccharalis* **Fabr.**) **y las perspectivas para su control permanente en el Perú.** [The Sugar-cane Moth Borer. Observations on *D. saccharalis* and the Prospects for its permanent Control in Peru.]—25 pp., 2 pls., 13 refs. Lima, Soc. nac. agrar., Com. Prod. Azúc., 1950.

The author carried out a survey in September–October 1949 of the areas in which sugar-cane is grown in Peru to study infestation by *Diatraea saccharalis* (F.), the only important insect pest of the crop there. The subtropical climatic conditions and the general agricultural ecology of the cultivated coastal valleys are described, and the history of *D. saccharalis* as a pest of sugar-cane and maize in Peru is reviewed. The general infestation in sugar-cane was extremely high, and losses were estimated at 15 per cent. of the value of potential annual crop. The percentages of internodes showing visible damage externally varied greatly in different fields, even on a single plantation, but there was a marked tendency for fields of plant canes to be more heavily attacked than ratoon fields. In the Pativilca valley, the percentages averaged 17·4 for plant cane and 16·7 for ratoons, while in the more northern valleys of the Rio Chicama and Santa Catalina (Trujillo) and of the Lambayeque (Chiclayo), the averages were 40 and 21·5, respectively. Examples of the reduction in sugar-content in bored canes as compared with unbored canes are shown in tables. Infestation by *D. saccharalis* is favoured by the long growing period of the cane, which requires 20–24 months to reach maturity, and the use of the variety P.O.J.2878, which is known to be highly susceptible to borer damage. Evidence is given that the practice of burning the fields before harvest is not necessarily responsible for increasing borer damage. It is suggested that under the isolated conditions of the coastal valleys, *D. saccharalis* may have developed a virulent strain on sugar-cane.

Previous work on the parasites of *D. saccharalis* in Peru is reviewed [*cf.* *R.A.E.*, A **21** 505]. The egg-parasite, *Trichogramma minutum* Ril., was found in all plantations visited except one in Trujillo, in which large-scale liberations of artificially reared *Trichogramma* had been made regularly for the past 20 years without reducing infestation appreciably. The larvae were parasitised by the Braconids, *Ipobracon rimac* Wolc. and *Agathis* (*Microdus*) *stigmatera* (Cress.), neither of which was frequent, and the Tachinid, *Paratheresia claripalpis* (Wulp), which was found at all places visited and frequently attacked high percentages. *P. claripalpis* was of considerable importance as a parasite of *D. saccharalis* on both sugar-cane and maize, but its efficiency was reduced by the presence of numerous hyperparasites. A sample of larvae and pupae of the Pyralid, *Doratoperas atrosparsellus* (Wlk.), which causes dead-hearts in the giant wild cane, *Gynerium sagittatum*, collected in Trujillo, showed 66·6 per cent. parasitism by *Paratheresia*, almost certainly *P. claripalpis*, as many as nine parasites developing in one host larva. Adults had emerged from the puparia, but 75 per cent. of the latter showed evidence of attack by an unknown Hymenopterous hyperparasite.

The prospects for the biological control of *D. saccharalis* in coastal Peru are considered favourable, and it is recommended that a properly organised campaign should be begun, using in a planned sequence the Dipterous parasites that are known to have controlled the borer in other countries.

At Iquitos, on the River Amazon, where a study of the ecology of *D. saccharalis* and related borers was made, *D. saccharalis* was not found in native plots of sugar-cane, although adjacent maize and certain wild grasses were heavily attacked ; a moderate infestation was observed in teosinte (*Euchlaena mexicana*) at the Government Experiment Station. The borers found in sugar-cane were *D. albicrinella* Box, which was frequent, and *D. impersonatella* (Wlk.), *Xanthopherne* sp. (probably *X. bimaculata* Box), *Castnia* sp. and *Metamasius hemipterus* (L.), which were rare. The river and its tributaries are bordered by belts of *Echinochloa polystachya*, with *Paspalum fasciculatum* further inland. Larvae of *D. saccharalis* were frequent on *Echinochloa*, 48 per cent. of them being parasitised by *Metagonistylum minense* Tns. and 28 per cent. by *Leskiopalpus diadema* (Wied.), with occasional parasitism by *A. stigmatera* and *Spilochalcis* sp. ; *M. minense* also attacked the borer on maize. A dark form of *T. minutum* was reared from the eggs of *D. saccharalis*, which were often found in masses on the stalks of *Echinochloa*, as well as on the undersides of the leaves. *D. albicrinella* was found on *P. fasciculatum*, *P. virgatum* and *Andropogon bicornis*, and one larva on *P. virgatum* was found parasitised by *Paratheresia claripalpis*, which was otherwise conspicuously absent as a parasite of *D. saccharalis* in the region.

The second paper is a translation of the first, but the record of *Paratheresia* from *Doratoperas atrosparsellus* is omitted.

Box (H. E.). **Informe preliminar sobre los barrenadores o " borers " de la caña de azúcar** (*Diatraea, Chilo*) **en México, a base de un viaje de reconocimiento efectuado durante marzo-abril, 1951, a las regiones cañeras : I—Sinaloa, II—Nayarit, y XIV—Huasteca ; con observaciones complementarias.** [Preliminary Report on the Sugar-cane Borers (*Diatraea, Chilo*) in Mexico, based on a Survey carried out in March–April 1951 in the Cane Regions of Sinaloa, Nayarit and Huasteca, with supplementary Observations.]—93 [+1] pp., 1 fig., 7 fldg. maps, 88 refs. Mexico, D.F., Un. nac. Prod. Azúc., 1951.

The author carried out a survey in March–April 1951 of the sugar-cane areas in the States of Nayarit, Sinaloa and Tamaulipas, Mexico, to determine the status of the stalk-borers of the genera *Diatraea* and *Chilo* that attack sugar-cane and maize there. The nature of the problem is discussed, and a list is given of the various species of these genera that occur in Mexico and adjacent territories, with notes on their general and local distribution and the identity of a few of them. The species of economic importance in Mexico are *D. considerata* Heinr. (which has been erroneously recorded as *D. canella* Hmps. [*R.A.E.*, A **14** 540] and *D. magnifactella* Dyar [**19** 376]), *D. magnifactella* and possibly also *C. morbidellus* Dyar, which attack sugar-cane only ; *D. saccharalis* (F.), *D. grandiosella* Dyar and *C. loftini* Dyar, which attack sugar-cane and maize ; and *D. lineolata* (Wlk.), which has been misidentified as *D. grandiosella* [**14** 540] and attacks maize only. The areas of distribution of the economic species of *Diatraea* in Mexico are shown on maps.

The general ecology of the borers is discussed in a special section, in which lists are given of their cultivated and wild food-plants and their natural enemies, based partly on the literature. *D. considerata* and *D. magnifactella* are believed to be indigenous in Mexico, although no truly wild food-plants of either have yet been discovered. The need for a thorough ecological investigation, especially of the indigenous species, is stressed. The parasites recorded from Mexico include *Trichogramma minutum* Ril., which attacks the eggs of *Diatraea* but was not found because of the season, and various species that attack the larvae. These comprise *Chelonus sonorensis* Cam., *Mesostenus* sp. and two unidentified species of *Mallochia*, from *Chilo*, of which the first was the only one that appeared to be of any value against *Chilo* on sugar-cane and was also reared from *D. grandiosella* on maize ; *Apanteles diatraeae* Mues. and four unidentified Braconids and Ichneumonids, all attacking *Diatraea* ; a Tachinid referred to as *Phorostoma* sp. [*cf.* **12** 167 ; **14** 541] from *D. considerata* on sugar-cane in Nayarit ; and *Paratheresia claripalpis* (Wulp), which parasitised *D. considerata* on sugar-cane in Nayarit and Sinaloa, but does not apparently attack *D. grandiosella.* It also parasitised *D. lineolata* and *D. saccharalis* on maize and the latter also on sugar-cane in Tamaulipas, San Luis Potosí and northern Veracruz, but did not attack *D. magnifactella* in that region, though it parasitised it in southern Veracruz and the central States. Because of its present and potential importance, a detailed account is given of the distribution, synonymy and host relations of *P. claripalpis,* with a list of authentic Mexican records and a map showing its distribution in Mexico. The author considers that *P. claripalpis* has various biological races differing in their host affinities and suggests that it might be advantageous to produce hybrids among these for use in Mexico and elsewhere. When females of *P. claripalpis* from Venezuela were crossed with males from Trinidad, a hybrid race was produced that developed in *D. lineolata* (which is rarely parasitised in Trinidad) and possessed an increased ability to attack *D. saccharalis* and *D. rosa* Heinr.

Accounts are given of the observed status of the various sugar-cane borers and their parasites in each of the regions and zones visited, with the degree of infestation in each. The worst damage observed was caused by *D. considerata* at Villa Unión, Sinaloa, where several hundred acres of plant cane of the 1950–51 crop were destroyed on one plantation. *D. grandiosella* caused severe damage to sugar-cane at Los Mochis, northern Sinaloa, where the situation was complicated by the presence also of *C. loftini.* *D. considerata* was the principal pest in southern Sinaloa. *D. saccharalis* was not found in western Mexico, but is a major pest on two large plantations in Tamaulipas, where *D. magnifactella* also occurs and is sometimes abundant. Each of these two borers seems to have its own sphere of dominance in the Huasteca region. In Puebla, attacks by *D. magnifactella* are severe and are sometimes complicated by the presence of *D. grandiosella.* In Morelos and southern Veracruz, where *D. magnifactella* is the commonest borer in sugar-cane, the attack is not heavy, possibly because of the abundance of *P. claripalpis.* Maize is attacked by *D. saccharalis* and *D. lineolata* in the eastern and central States, by *D. grandiosella* in the central, western and north-western States, and by *Chilo* chiefly in Sinaloa.

Recommendations are made for a comprehensive programme of research directed towards the biological control of *Diatraea* spp. by means of Dipterous parasites ; in the case of *Chilo,* only the Hymenoptera seem to offer hope of reduction. It is suggested that the Tachinid, *Lixophaga diatraeae* (Tns.), should be introduced at once against *D. saccharalis* in Tamaulipas, followed if necessary by *Metagonistylum minense* Tns. A thorough investigation of the possible local races of *P. claripalpis* in Mexico is required, to determine their host relationships and adaptability, and the importation of suitable other races of this parasite is recommended, particularly against *D. grandiosella, D. magnifactella* and *D. considerata,* against which neither *Lixophaga* nor *Metagonistylum* is likely to prove successful.

BROOKS (A. R.). **Identification of the Root Maggots (Diptera : Anthomyiidae) attacking cruciferous Garden Crops in Canada, with Notes on Biology and Control.**—*Canad. Ent.* **83** no. 5 pp. 109–120, 32 figs., 9 refs. Ottawa, 1951.

In view of uncertainty as to the status and identity of the Dipterous larvae associated with the roots of cruciferous crops in Canada, collections were made throughout the country in 1946–50 [*cf. R.A.E.*, A **38** 398]. Nearly 30 species were represented, and a list of them is given arranged according to feeding habits. Only *Hylemyia brassicae* (Bch.), *H. crucifera* Huckett and *H. planipalpis* (Stein) were responsible for extensive injury, though five other species sometimes damage the roots under certain conditions ; these were rarely found alone and *H. fugax* (Mg.), *Muscina assimilis* (Fall.) and *M. stabulans* (Fall.) were infrequent, but *H. cilicrura* (Rond.) and *H. trichodactyla* (Rond.) were abundant and important. Keys are given to the adults of these eight species and to the eggs (so far as these can be separated) and larvae of seven of them, and the paper also includes notes on the nomenclature of some and a table showing the distribution of the three most important species in Canada, the seasons at which they are present, the number of generations a year and an indication of their food-plants. *H. brassicae, H. crucifera, H. cilicrura, M. stabulans* and *M. assimilis* were widespread, but *H. planipalpis* was confined to western Canada and *H. trichodactyla* and *H. fugax* to the east, except for records from the Yukon and British Columbia, respectively. *H. brassicae* is the major pest of radish, turnip, cabbage and other cruciferous crops in British Columbia and from Ontario to Newfoundland. It has 3–5 overlapping generations a year, and all stages are present from April to October. The eggs of this species and of *H. crucifera,* which is the major pest of turnip, cabbage and cauliflower in Alberta, Saskatchewan and Manitoba, especially in timbered areas, are laid in groups on the stem at or a little below soil level or on the petioles of the lower leaves. Both species chiefly damage the roots and stems and the injury is visible externally, but *H. brassicae* sometimes damages the heads of cauliflower and brussels sprouts early in the season, and such damage is not obvious externally. Populations of 5–10 larvae of *H. brassicae* can destroy a young plant, but older ones can support 100 or more if healthy and well supplied with water. *H. crucifera* normally has only one generation a year. Adults appear in early July, eggs and larvae become numerous in the second half of July and in August, and eggs are present until September. Under favourable growing conditions cauliflower and cabbage are not seriously damaged unless more than 80 larvae are present. *H. planipalpis* appears to be the major pest of radish in Alberta, Saskatchewan and Manitoba and does not attack other cultivated crops. The eggs are laid singly or in twos or threes on the exposed part of the root or on the petioles, and the larvae feed within the root ; the damage is not visible externally. Owing to the small populations, the plant is rarely killed. First-generation adults emerge about 15th June after a pupal stage of ten days. In Saskatchewan, there are several generations a year and all stages are present throughout the season. *H. cilicrura* and *H. trichodactyla* are difficult to separate, have similar bionomics, and are not restricted to crucifers. The larvae occur in tunnels made by *H. brassicae* or *H. crucifera* and normally form about 10 per cent. of the population. The eggs are laid in small masses on the stems or petioles, usually rather higher up than those of *H. brassicae* and in smaller numbers. The larvae appear in late June, are common in August, and are scarce on crucifers after mid-September. There appear to be two or three generations in the roots. The few collections of *H. fugax* were made on cauliflower, turnip, brussels sprouts and cabbage. In the absence of other species, the larvae of *M. assimilis* and *M. stabulans* construct burrows resembling superficial ones of *H. brassicae.* They become full-fed by the end of July, and are sometimes parasitic on Lepidopterous larvae.

BRADLEY (G. A.). **Notes on the Parasitism of the Yellow-headed Spruce Sawfly,** *Pikonema alaskensis* **(Roh.) (Hymenoptera : Tenthredinidae).**—*Canad. Ent.* **83** no. 5 pp. 130–131. Ottawa, 1951.

Some of the insecticides tested in experiments on the control of the yellow-headed spruce sawfly, *Pikonema alaskensis* (Rohw.), in farm shelter-belts in

Saskatchewan also destroyed its parasites. Investigations on the latter were therefore begun, and those that emerged from the host cocoons were studied in 1949–50. The soil beneath the canopy of five trees was replaced to a depth of 6 ins. with soil free from cocoons in the summer of 1949, and later in the season, the cocoons formed in it were recovered by sifting and kept for emergence. The results are shown in a table. Mortality among both parasitised and unparasitised sawflies was high. The parasites reared comprised nine Ichneumonids, two unidentified Bethylids and a Tachinid. Adults of *P. alaskensis* emerged between 3rd and 21st June and represented 49·4 per cent. of the 940 adults obtained. Of the parasites, all of which emerged between 12th June and 15th July, *Rhorus* sp. represented 18·5 per cent. of all adults, and *Lamachus lophyri* (Ashm.), *Syndipnus gaspesianus* (Prov.) and *Smicroplectrus velox* Walley 8·3, 8·0 and 7·8 per cent., respectively.

Morris (R. F.). **The larval Elateridae of eastern Spruce Forests and their Role in the natural Control of** *Gilpinia hercyniae* **(Htg.) (Hymenoptera: Diprionidae).**—*Canad. Ent.* **83** no. 6 pp. 133–147, 1 fig., 6 refs. Ottawa, 1951.

In the course of investigations on the natural control of *Gilpinia hercyniae* (Htg.) during the outbreak on spruce in eastern Canada [*R.A.E.*, A **31** 213; **38** 183], cocoons were found with openings smaller than those made by predacious mammals, and such cocoons occasionally had an Elaterid larva partly inside. Studies on the importance of these larvae in control were therefore made in central New Brunswick and the Gaspé Peninsula (Quebec) in 1939–46, in the course of which some 20 species were collected from the litter under spruce trees. A list of these is given, together with a key for their identification by R. Glen. The following is taken from the author's summary of the work.

Nearly 90 per cent. of the larvae collected in New Brunswick were of the genus *Ctenicera*, and 55 per cent. were *C. triundulata* (Randall) and *C. nitidula* (Lec.). The other common genera were *Agriotes*, *Dalopius* and *Ampedus*. The Gaspé population consisted largely of *Eanus decoratus* (Mannh.), and the presence of this species is believed to have been due largely to the deep moss layer of the collecting area. A similar species composition for New Brunswick prevailed among adult Elaterids collected from spruce foliage throughout the Province, except that additional species from nearby cultivated land were present. Populations of Elaterid larvae, as measured over a period of years, varied from 0·24 to 1·04 per sq. ft. on different permanent plots. Deep litter layers appeared to harbour higher populations than shallow ones. Population changes from year to year showed no relation to the population trend for sawfly cocoons as measured on the same plots.

Food habits were studied by means of individual rearings. All species attacked sawfly cocoons, sawfly adults that had emerged from them and potato tubers. Decaying twigs in the litter were not eaten, but were used as shelters for moulting and pupation. Whether smaller particles of humus were eaten was not observed. On the average, a larva destroyed one cocoon every four months. There was no significant preference as between cocoons and potato or between cocoons and sawfly adults. Cocoons containing living or newly dead insects were preferred to those containing insects that had been dead for some time. Since no specific differences in food habits were apparent, it is concluded that the Elaterids that inhabit spruce litter may for ecological purposes be treated as a single group. In comparison with small mammals, Elaterid larvae play only a minor part in the complex of control factors affecting the cocoons, analysis of extensive collections from New Brunswick and Gaspé showing that only 1–2 per cent. were destroyed by them. Several species of insects that were associated with Elaterids in the litter are also discussed. Of these, only adult Carabids readily attacked the cocoons.

LEJEUNE (R. R.). **Some ecological Factors governing Populations of the Larch Sawfly,** *Pristiphora erichsonii* (**Htg.**).—*Canad. Ent.* **83** no. 6 pp. 152–156, 7 refs. Ottawa, 1951.

Studies on the ecological factors affecting populations of *Pristiphora erichsonii* (Htg.) on larch in Saskatchewan and Manitoba have been made throughout the present outbreak, which began about 1939 [*cf. R.A.E.*, A **37** 441], and the author reviews the results of some of the work, which is still largely unpublished. Soil moisture appears to be the most important physical factor [*cf.* **37** 442 ; **38** 1]. W. H. Fell & D. P. Burbidge have shown that the effects of flooding depend on its duration and the stage concerned. Overwintered diapausing larvae did not survive spring floods that persisted for more than six weeks, and shorter periods of flooding caused high mortality, though this was not proportional to their duration. The development of larvae that survived flooding was retarded. After diapause was broken, immersion for periods varying from 3 days to 2½ weeks was fatal, the most advanced stages being killed most quickly ; individuals that have completed their diapause are most numerous about the middle of June. Larvae that had constructed their cocoons less than two weeks previously rarely survived submergence for two or more weeks. Resistance increased gradually and became constant, presumably at the level found among diapausing larvae in spring, about the end of September, 8–10 weeks after the construction of the cocoons. The effect of flooding on the trees and natural enemies is not known, but when it gives complete control of the sawfly, the trees probably benefit ; where only partial control is given, natural enemies may react unfavourably.

The chief parasites of *P. erichsonii* in the two Provinces are the Ichneumonid, *Mesoleius aulicus* (Grav.) [**37** 271, 442], which is probably introduced, and the Tachinid, *Ptychomyia selecta* (Mg.) (*Bessa harveyi* (Tns.)) [**37** 271], which may be derived from introduced European stock. *M. aulicus* occurs wherever the sawfly is present, and is most abundant in northern Saskatchewan and south-western Manitoba. The percentage of larvae in which eggs were laid was often high and occasionally reached 60–70, but the resulting mortality rarely exceeded 5 per cent., owing to the low percentage hatch, which ranged from 7·5 to 20 in 1948 and from 10 to 90 in 1949. J. A. Muldrew found this to be due to encapsulation of the eggs in the host larvae. *M. aulicus* gives more effective control in British Columbia, but parasites from that Province being released in the Prairie regions are also likely to be checked by this reaction. *P. selecta* was scarce or absent until 1945, but has since increased steadily in the older, declining infestations in western, eastern and central Manitoba, where it is now more important than *M. aulicus*. It sometimes parasitises over 45 per cent. of the larvae. In the more recently attacked areas, it is being recovered in small but increasing numbers. Earlier estimates of its incidence were probably too low, since they took no account of the larvae that leave the host cocoons in late summer to pupate and overwinter in the soil and first-generation adults that emerge during the summer. *Tritneptis klugii* (Ratz.) and *Aptesis basizona* (Grav.) from the Dominion Parasite Laboratory, Ontario, were released in 1949 and 1950. *T. klugii* formerly occurred in the Prairie Provinces, but was not recovered during the current outbreak and may be unable to survive periods of low host density. Of the predators, mice and shrews are the most important [*cf.* **37** 442], but Elaterid larvae also destroy a small number of cocoons, and nymphs of *Podisus* sp. have been observed feeding on the eggs and larvae and may be of some value. Many bacteria have been isolated from dead sawflies in the field, and fungi of several genera have been cultured from dead larvae and pupae ; some of the fungi have given fairly high mortality in laboratory tests, but attempts to establish them in the field have not proved encouraging.

A further factor limiting populations of *Pristiphora* is the food-plant itself, since after suffering severe infestation for 3–4 years, the trees are unable to produce enough leaves to support many larvae or many long terminal shoots on which eggs can be laid. Severe infestation may therefore be less injurious than a more moderate, but prolonged, attack.

Evidence has been obtained that the three factors considered, alone or in combination, are able to bring infestations under control. Abnormally high water levels in the spring of 1950 controlled populations in eastern Manitoba that had been reduced by *Ptychomyia* in 1948 and 1949, and the activity of this parasite, mice and shrews controlled two outbreaks in Manitoba, in one of which reduced growth of the trees contributed. The ability of the latter factor to control infestation alone has not been demonstrated, but it limits populations so that they can be checked by natural enemies and prevents populations that have been controlled by them from again rapidly increasing ; in some cases, it appears to have maintained populations at low levels when natural enemies and moisture were unable to give complete control.

PAGÁN (C.), HAGEMAN (R. H.) & LOUSTALOT (A. J.). **The Effect of Sun, Shade and Oven-drying on the toxicological and chemical Values of Derris Root.**—*J. agric. Res.* **78** no. 11 pp. 413–416, 7 refs. Washington, D.C., 1949.

Whole fresh derris roots grown in Porto Rico were dried in the sun or shade or in an oven for 1 hour at 80°C. and then for periods of 4 hours at 50°C. alternated with 4-hour periods in a desiccator, and split roots were dried in the sun or shade [*cf. R.A.E.*, A **36** 51]. Their rotenone contents were almost identical, and there were no significant differences in rotenone equivalent as determined by bioassay [**38** 64] between whole or split roots dried in the sun or shade. The rotenone equivalent of whole roots dried in the oven was significantly lower, however, indicating that some toxic constituents other than rotenone had been destroyed or changed by the treatment. The values for the red-colour test [*cf.* **34** 218] did not differ appreciably among the samples after any of the treatments, although there was a tendency for them to be somewhat higher when the rotenone equivalent was high. There was no statistically significant deviation in the total chloroform extractives [*cf.* **37** 261] of the roots subjected to the various treatments, and the percentage transmittance values of acetone extract of the roots [*cf.* **37** 259] gave the best correlation with the rotenone equivalents.

It is concluded that derris roots may be dried in sun or shade without appreciable loss in toxicity, but that drying them in an oven results in lower toxicity, even though there is no loss of rotenone.

MUNGER (F.). **Rate of Development of California Red Scales resistant and nonresistant to Hydrocyanic Acid Gas, as affected by Temperature.**—*J. agric. Res.* **78** no. 11 pp. 451–456, 5 refs. Washington, D.C., 1949.

The following is based on the author's summary. The duration of development on lemons of strains of *Aonidiella aurantii* (Mask.) resistant and nonresistant to hydrocyanic acid gas [*cf. R.A.E.*, A **37** 165] was studied at constant temperatures of 64·4–93·2°F. and at fluctuating temperatures ranging from 64·4 to 86°F., as under moderate spring and summer conditions, and from 47·5 to 107·8°, as under conditions in the interior of California. There were small differences between the strains at fluctuating temperatures of 64·4–86° and at a constant temperature of 86°, but no significant differences at other temperatures, though there was some evidence that the resistant scales may develop less rapidly than the non-resistant ones at high temperatures and more rapidly at low temperatures. At constant temperatures, a later generation required slightly but significantly longer to complete development than an earlier one. The proportion of females that survived and reproduced increased as the constant temperature rose from 64·4 to 86°F. More resistant than non-resistant females reproduced at 64·4° and more non-resistant females at 93·2°. When the temperature fluctuated, there was no apparent difference in mortality between the strains, and the numbers of scales that reproduced were nearly equal in the two ranges of temperature.

GRIFFITHS jr. (J. T.) & STEARNS jr. (C. R.). **The Effects of Airplane DDT Applications on *Citrus* Groves in Florida.**—*J. agric. Res.* **78** no. 11 pp. 471–476, 7 refs. Washington, D.C., 1949.

The following is substantially the authors' summary and conclusions. In 1947, aeroplanes were used extensively to distribute about 4 oz. DDT per acre for mosquito control in Brevard County, Florida, 4–10 applications being made, and a study of the amounts of p,p'DDT deposited on *Citrus* foliage after the last application and of its effects on the parasites and predators of *Chrysomphalus ficus* Ashm. (*aonidum*, auct.) on *Citrus* was made. No deposits of more than 0·3 mmg. DDT per sq. cm. were found, and parasite and predator populations were apparently normal in November, after the spraying season was over. Most of the DDT retained by the foliage appeared to have been absorbed into the leaf tissue. It is concluded that the DDT sprays would have no detrimental effects on the control of *C. ficus*.

GREENWOOD (M. L.) & TICE (J. M.). **Palatability Tests on Potatoes grown in Soil treated with the Insecticides Benzene Hexachloride, Chlordane, and Chlorinated Camphene.**—*J. agric. Res.* **78** no. 11 pp. 477–482, 2 refs. Washington, D.C., 1949.

The effect of soil treatment with BHC (benzene hexachloride), chlordan and chlorinated camphene [toxaphene] against wireworms on the flavour of potato tubers was tested in Connecticut in 1947 [*cf.* *R.A.E.*, A **37** 252]. The tubers were boiled and submitted to tasters. The results showed that crude BHC imparted a particularly objectionable flavour, which was detected at the minimum rate of application tested (1 lb. per acre) and increased in intensity with the rate. Inconclusive evidence indicated that potatoes grown in soil treated in the preceding year were tainted in the same way. Pure γ BHC imparted a foreign but less objectionable flavour. Potatoes grown in soil treated with 1–8 lb. chlordan or toxaphene per acre showed some foreign flavour but there was no apparent relationship between its intensity and the rate of application. Chlordan was less objectionable than toxaphene.

STANDEN (J. H.). **A simple Apparatus for Assay of Fumigant Insecticides.**—*Contr. Boyce Thompson Inst.* **15** no. 3 pp. 127–129, 2 figs. Menasha, Wis., 1948.

The author describes and figures an apparatus that has proved satisfactory for testing chemicals as fumigants for the control of greenhouse pests. It consists of a series of heating coils by which weighed samples of materials can be vaporised in ten minutes or less in known volumes of air, in the presence of the pests on food-plants. A 15-litre battery jar is used as the fumigation chamber, and chemicals are tested first at the rate of 0·1 gm. solid or 0·1 cc. liquid in such chambers and later at lower concentrations if desired. Fumigation is begun in the late afternoon, and the insects or mites are examined for mortality the next morning ; sunlight is apt to increase injury to plants by the chemicals when the tests are set up earlier in the day.

Hartzell (A.), Haynes (H. L.) & Connola (D. P.). **Apparatus used in Laboratory Insecticide Tests at Boyce Thompson Institute.**—*Contr. Boyce Thompson Inst.* **15** no. 3 pp. 131–140, 3 figs., 17 refs. Menasha, Wis., 1948.

The following is substantially the authors' summary. Apparatus used in conducting insecticide tests at Boyce Thompson Institute is described and illustrated. It consists of a series of cages in a culture room for rearing insects under controlled conditions of temperature, humidity, and light, and a testing laboratory containing a combined spray and dust hood with a motor-driven turntable mounted in it. Spray apparatus and exposure chambers are also described.

Flemion (F.), Poole (H.) & Olson (J.). **Relation of *Lygus* Bugs to embryoless Seeds in Dill.**—*Contr. Boyce Thompson Inst.* **15** no. 6 pp. 299–310, 1 fig., 38 refs. Menasha, Wis., 1949.

The low germination rate of the seed of several umbelliferous crops has been found to be due to the destruction of the embryos in the seed. A survey of the insects visiting carrot, dill and fennel at Yonkers, New York, in 1947 showed that nymphs and adults of *Lygus oblineatus* (Say) were present from the flowering period to the mature-seed stage, and in the summer of 1948, these and other insects found on umbelliferous plants were caged on potted dill plants for various periods to determine their effect on seed development. The plants were transferred to insect-free cages when the first umbel on each plant was showing signs of development, and house-flies [*Musca domestica* L.] were introduced into all cages to act as pollinators. Insects collected on umbelliferous plants were then liberated in all cages except the controls. Seeds without embryos almost invariably occurred in the cages in which these liberations were made and were usually very numerous on plants or specific umbels exposed to nymphs or adults of *L. oblineatus*, even when the exposure was only for 48 hours to a single adult or for 96 hours to four nymphs, but rarely occurred on plants caged with ants, Lampyrids, Chrysopids, Coccinellids, Syrphids or adults of *Popillia japonica* Newm. or on the controls. There appeared to be no relation between the occurrence of seeds without embryos and seed yield, but a considerable reduction in the number of seeds produced when *Lygus* was present during the flowering period. It is concluded that *Lygus* bugs are a factor in the production of embryoless seeds, and the tendency for the proportion of these to increase as the season progresses may be due to the increase of the *Lygus* population. Preliminary tests indicated that *Lygus* also destroys the embryos of carrot seeds.

In tests on the control of *Lygus*, sprays of DDT, nicotine and TEPP (tetraethyl pyrophosphate) were applied directly to both nymphs and adults. TEPP at 0·03–0·125 per cent. gave complete mortality in 1½ hours, but the effect of the other insecticides was much more variable and not so rapid. TEPP hydrolysed so quickly that it had no persistent effect, and it caused no damage to the plants.

DRESNER (E.). **Culture and Use of entomogenous Fungi for the Control of Insect Pests.**—*Contr. Boyce Thompson Inst.* **15** no. 6 pp. 319–335, 2 figs., 8 refs. Menasha, Wis., 1949.

An account is given of laboratory and field observations, some of which are noticed in more detail elsewhere [*R.A.E.*, B **39** 207], on the value of entomogenous fungi for the control of insect pests, carried out mostly in New York. Two species of fungi were available for culture ; *Metarrhizium glutinosum* proved non-pathogenic to laboratory insects, and attention was therefore concentrated on *Beauveria bassiana.* Mass cultures of it were established on various vegetable media, chiefly water-saturated bush beans, infected by spraying with suspensions of spores from test-tube cultures on molasses agar or other agar mixtures. The process of culturing and the optimum conditions for it are described ; 1 lb. beans yielded 60 gm. spores, enough to dust three acres. The carrier finally adopted for the dusts was wheat flour. Sprays were also used and were more effective than dusts, especially when a wetting agent was added, but required more spores to prepare. A list is given showing the insects that proved susceptible to infection in the laboratory or field, including 25 named species in six Orders. Insects attacked became paralysed and died. The effect was due partly to parasitism and partly to a constituent of the mycelium, which killed mosquito larvae at less than 200 parts per million.

Adults of *Calandra* (*Sitophilus*) *oryzae* (L.) kept at 65–85°F. and 35–85 per cent. relative humidity in rice grains that had been dusted with 0·3 per cent. pure spore material by weight were all dead in 13 days. Late-instar nymphs of *Periplaneta americana* (L.) all died in 7, 7 and 14 days at 70–90°F. and 80–95 per cent. relative humidity following treatment by injection with a 1 per cent. spore suspension, feeding on rat pellets sprayed with 1 per cent. spore suspension and dusting with spores, respectively. Larvae of *Muscina stabulans* (Fall.) feeding within a cockroach that was killed by the fungus completed their development when transferred to a fresh host. Agamic examples of *Aphis fabae* Scop. (*rumicis* auct.) all died in three days at 70–90°F. and 90–100 per cent. relative humidity after being sprayed with 0·1 per cent. spore suspension. Field infestation of rose by *Macrosiphum rosae* (L.) was greatly reduced in five days and eliminated in ten after the plants had been dusted with 0·5 per cent. spore dust, some of the Aphids being killed by the fungus, and more by predacious Syrphids and Chrysopids, eggs, larvae and adults of which were not affected by it. Results against larvae and adults of *Tribolium confusum* Duv. were unsatisfactory, bran media estimated to contain 0·1 per cent. by weight of spores causing only 46 per cent. reduction in population after 14 days at 70–90°F. and 35–95 per cent. relative humidity. *Tetranychus bimaculatus* Harvey on beans dusted in the field with 0·5 per cent. spore dust on 16th July showed 71·1 per cent. mortality by 21st July at an average temperature of 74°F. and relative humidity at 7.30 a.m. of 91·3 per cent., but it is believed that the actual kill was higher. Mites on untreated beans downwind from treated ones showed 25·5 per cent. mortality, partly due to fungus infection. In laboratory and field tests, all stages of *Epilachna varivestis* Muls. on beans and lima beans were attacked by the fungus. Dusting with 0·5 per cent. spores gave complete mortality of eggs, and two applications of 10 lb. 1 per cent. dust per acre on 24th and 26th August caused much greater reductions of all stages than one application of 20 lb. 0·75 per cent. rotenone dust per acre on 25th August. Adults and nymphs of *Podisus maculiventris* (Say) were feeding on the larvae in untreated plots and also in those treated with the fungus, but not in the rotenone plots. Almost daily rainfall increased the effectiveness of the fungus and reduced that of rotenone.

Though their hosts had been killed by dusting with the fungus, larvae and pupae of *Apanteles congregatus* (Say) parasitising larvae of *Protoparce quinquemaculata* (Haw.) and three pupae of *Compsilura concinnata* (Mg.), two recovered from *P. quinquemaculata* and one from a mass of adults of *Popillia japonica* Newm., completed their development.

The inhalation of small clouds of spore dust had no harmful effect on those handling the fungus, and rats showed no adverse effects after receiving injections of 0·5 cc. of a suspension of 1 per cent. spores in the abdominal cavity or 0·25 cc. in the muscle, or after feeding on 0·5 gm. spores in bran and molasses. Slugs (*Limax* sp.) dusted in a moist chamber died in 5–14 days. There were no serious effects when the spores were sprayed or dusted on normal plant material, but the fungus germinated, grew and sporulated when spores were sprayed or dusted on bean leaves removed from the stem and kept in a moist chamber, and a 0·5 per cent. dust applied to an orange fruit infested by *Scirtothrips citri* (Moult.) caused a heavy growth of fungus over the entire orange and the thrips after six days. Grasses and weeds on which infected insects had died were not affected by the fungus, even when the humidity was optimum for spore germination.

Two natural outbreaks of *Empusa americana* on blowflies were observed. It was found that such outbreaks require a long period of optimum conditions for the incubation of sufficient numbers of spores to infect the entire population. The fungus was isolated from one outbreak and cultured in the laboratory. It proved capable of killing house-flies (*Musca domestica* L.), but was much less effective than *B. bassiana*.

It is concluded that the main limiting ecological factor in the successful use of artificially spread fungus spores is atmospheric humidity. The best form of moisture was rainfall, about half an hour's rain being sufficient to permit infection of the insects. Optimum humidity was present during the observations reported and is common each summer in the lower New York area. It is considered that entomogenous fungi can be depended on to control insect infestation in the areas of frequent rainfall and high humidity on the Atlantic coast of the United States but not in others. If conditions are favourable, inexpensive long-lasting control is likely to result.

Beck (S. D.), Lilly (J. H.) & Stauffer (J. F.). **Nutrition of the European Corn Borer, *Pyrausta nubilalis* (Hbn.). I. Development of a satisfactory purified Diet for larval Growth.**—*Ann. ent. Soc. Amer.* **42** (1949) no. 4 pp.483–496, 7 graphs, 10 refs. Columbus, Ohio, 1950.

The following is substantially the authors' summary. The digestive tracts of larvae of *Pyrausta nubilalis* (Hb.) were found to contain a protease, a peptidase, a lipase and an invertase. A purified diet allowing apparently optimum growth of the larvae was developed, consisting of glucose, casein, cholesterol, maize oil, Wesson's salts, brewer's yeast powder, choline chloride and lyophilised maize leaves suspended in an inert carrier consisting of aqueous agar and fibrous cellulose [*cf. R.A.E.*, A **38** 421]. Mixtures of ten B vitamins failed as substitutes for brewer's yeast powder in the larval diet under the conditions of the experiments. Choline was found to be an essential factor and was required at relatively high levels. A " maize leaf factor " that has not yet been identified is required for optimum growth and is present in lyophilised maize leaves.

Smith (R. F.) & Michelbacher (A. E.). **The Development and Behavior of Populations of *Diabrotica 11-punctata* in Foothill Areas of California.**—*Ann. ent. Soc. Amer.* **42** (1949) no. 4 pp. 497–510, 8 figs., 5 refs. Columbus, Ohio, 1950.

The following is substantially the authors' summary. *Diabrotica undecimpunctata* Mannh. is a serious local pest of deciduous stone fruits in parts of California [*cf. R.A.E.*, A **30** 357]. There are three generations a year in most of central California and the winter is passed in the adult stage. The first spring generation occurs largely in uncultivated regions. Adults of this generation appear during late April, May and most of June, and are few in number unless there is adequate rainfall and a good growth of vegetation in the winter and early spring. They concentrate in large numbers on the flowers of such plants as *Phleum pratense* and *Anthemis cotula*, but as these dry up in the late spring,the beetles move into the cultivated areas, where they damage ripe stone fruits. A large rolling, grassy, uncultivated area close to a relatively small orchard area favours severe attack. Variations in rainfall from year to year affect the size of the suitable breeding area and consequently that of the population, and other crops, such as lucerne, attract a large proportion of the migrating beetles and reduce the damage to fruit. Apricots are the fruits most seriously attacked, but cherries, nectarines and peaches are also damaged.

Dickson (R. C.). **Factors governing the Induction of Diapause in the Oriental Fruit Moth.**—*Ann. ent. Soc. Amer.* **42** (1949) no. 4 pp. 511–537, 3 graphs, 29 refs. Columbus, Ohio, 1950.

The author reviews the literature on the factors inducing diapause in insects and describes investigations on those responsible for it in larvae of *Cydia* (*Grapholitha*) *molesta* (Busck), reared on apples, or occasionally peaches, and in a few other insects. The following is taken from his summary of the results.

The induction of diapause in *C. molesta* is controlled by temperature and daily exposure to light during the larval feeding period [*cf. R.A.E.*, A **35** 54]. Larvae that develop in the absence of light do not enter diapause, and as the period of light per day is increased beyond three hours, the percentage diapause increases, reaching 100 with about 12 hours of light per day. As the photoperiod is increased to more than 13 hours a day, the percentage diapause drops suddenly to almost zero, and remains at or near that point during further increases in light [*cf. loc. cit.*]. The photoperiodic effect is apparently caused by a hormone that is produced by a two-phase reaction during the larval feeding period. The light-induced phase requires not less than seven or more than 15 hours of light per day, and the darkness-induced phase not less than 11 or more than 16 hours of darkness per day to bring about an appreciable percentage of diapause. Diapause is induced only at medium temperatures ; either high or low temperatures during larval feeding prevent its occurrence.

Larvae of *Cydia* (*Carpocapsa*) *pomonella* (L.) enter diapause under the same conditions, except that they require a slightly higher temperature or a slightly longer photoperiod to prevent diapause ; those of *Lucilia sericata* (Mg.) enter diapause in response to low temperatures during the larval feeding period, the photoperiod having no effect ; and adults of *Listroderes obliquus* Gylh., which has only one generation a year, enter diapause in summer regardless of conditions.

Slifer (E. H.). **Vulnerable Areas on the Surface of the Tarsus and Pretarsus of the Grasshopper (Acrididae, Orthoptera) ; with special Reference to the Arolium.**—*Ann. ent. Soc. Amer.* **43** no. 2 pp. 173–188, 17 figs., 21 refs. Columbus, Ohio, 1950.

The following is based on the author's summary. The ventral surface of the arolia is impervious to water and unaffected by aqueous solutions of dyes in nymphs and adults of *Melanoplus differentialis* (Thos.) that have just moulted, but stains brightly if these are forced to walk or jump on sandpaper, and also in grasshoppers that have moulted some time previously, the cuticle of the ventral surface of the feet becoming abraded and permitting the entry of dye. The insects can repair damaged areas of the cuticle for some time after moulting, so that they again become impermeable to stains, but this ability seems to be lost as adults grow older.

The waterproof layer on the under surface of the arolium of *M. differentialis* appears to consist of a very thin layer of wax or wax-like material, and after its removal by xylol or carbon tetrachloride, the surface stains more brilliantly and uniformly than after abrasion, and water is lost or taken up through it with great rapidity. The cuticle on the under surface of the arolium is very thick and pliant and exhibits an unusual and complex microscopical structure. There was no evidence that the sense organs of the arolium served as sites for the entry of dyes.

An examination of specimens of 272 species of Acridids showed that the arolia of the Oedipodines are relatively small, those of the majority of the Cyrtacanthacridines large, and those of the Acridines for the most part intermediate in size. The euplantulae of older adults of *M. differentialis* and *Trimerotropis maritima* (Harr.) generally show one or more coloured patches when tested in dyes, usually where the cuticle is visibly damaged. In *M. differentialis*, the two euplantulae nearest the proximal end of the metathoracic tarsus are more easily damaged than the two that are distal to them and than any of those on the prothoracic and mesothoracic tarsi.

It is suggested that the arolia and the euplantulae of Acridids, particularly after they have become worn or injured, serve as areas through which insecticides enter with relative ease, and that these observations may explain the recorded susceptibility of *Locusta migratoria migratorioides* (R. & F.) to insecticides applied to the legs [*R.A.E.*, A **37** 20, 21].

BARBER (H. S.). **Notes on *Brontispa* in Micronesia (Coleoptera, Chrysomelidae).**—*J. Wash. Acad. Sci.* **40** no. 8 pp. 245–247, 13 refs. Baltimore, Md., 1950.

HAGEN (K. S.) & DOUTT (R. L.). ***Brontispa yoshinoi* Barber, a Description of adult and immature Stages (Coleoptera : Hispidae).**—*Ann. ent. Soc. Amer.* **43** no. 3 pp. 311–319, 17 figs., 6 refs. Columbus, Ohio, 1950.

In the first of these papers, the author discusses the means by which species of *Brontispa* and related genera may have become distributed on coconut on islands in the Indian and Pacific Oceans and points out the difficulty of identifying them and clarifying their affinities in view of the lack of specimens from the more obscure localities. He states that a species from coconut on Saipan, Mariana Islands, that was described by Chûjô as *Planispa castaneipennis* (the type of its genus) [*R.A.E.*, A **26** 336] has proved to be a synonym of *Brontispa mariana* Spaeth [**29** 331] and gives a description of *B. yoshinoi*, sp.n., from adults of both sexes on coconut in the Palau or western Caroline Islands. This latter species had been erroneously identified by the author as *B. chalybeipennis* Zacher and placed by Chûjô in *Planispa* [**26** 336], and characters are given distinguishing it from *B. chalybeipennis* and *B. mariana*. *B. chalybeipennis* does not occur in Palau. Hitherto unrecorded dimorphic characters of the males and females of it are described from adults collected in Ponape and Kusaie, eastern Carolines, and five atolls of the Marshall Islands.

The second paper contains detailed descriptions of all stages of *B. yoshinoi*, the habits of which closely resemble those of *B. mariana*. It attacks newly exposed leaf tissue, leaving a frond soon after it is fully expanded. In 1948, this Hispid was found to be generally distributed over southern Babelthuap, Koror, Arakabasan and Peleliu, in the Palau Islands, the most severe damage being observed on Peleliu.

Breakey (E. P.) & Batchelor (G. S.). **Phyllody of Chrysanthemum and the Eriophyid Mite,** *Paraphytoptus chrysanthemi* **Keifer.**—*Ann. ent. Soc. Amer.* **43** (1950) no. 4 pp. 492–494, 3 figs., 5 refs. Columbus, Ohio, 1951.

Chrysanthemum plants observed in Washington State in October 1948 to have suffered stunting of the internodes and transformation of the flowering parts to vegetative forms were found to be infested by *Paraphytoptus chrysanthemi* Keifer. The presence of large numbers of this Eriophyid in the deformed buds and the fact that related mites are known to cause malformations of various kinds in other plants suggested that they were the probable cause of the condition, which occurred in three varieties grown out of doors for cut flowers. It seems probable that the infestation originated from a shipment of chrysanthemum varieties from Japan soon after the end of the war ; the first indications of the condition appeared in 1947. This appears to be the first report of a probable relation between Eriophyid mites and phyllody, or the change of floral organs into leafy structures.

Rockwood (L. P.). **Entomogenous Fungi of the Genus** *Metarrhizium* **on Wireworms in the Pacific Northwest.**—*Ann. ent. Soc. Amer.* **43** (1950) no. 4 pp. 495–498, 9 refs. Columbus, Ohio, 1951.

A fungus observed developing on four larvae of *Limonius* sp. that were being reared in their native soil in the laboratory at Forest Gate, Oregon, in 1933 was identified as *Metarrhizium brunneum.* It was first noticed on 25th June and had killed all the larvae by 7th July. It was readily transferred to potato and later grown in pure culture on several media, including meat, fish and custard, and large numbers of wireworms that had been caged in infected soil were released in Idaho in 1940.

The author used this and pure cultures of *M. anisopliae* obtained from *Amara obesa* (Say) in Oregon in 1936 (Amara strain) and from *Limonius californicus* (Mannh.) in Idaho in 1937 (Idaho strain) to infect large numbers of wireworms during 1936–41. Naturally infected wireworms were eliminated, and healthy ones infected by shaking them in a container with the dry spores before they were introduced into sterilised cans containing moist sand or by introducing a small amount of sterilised dry sand mixed with a measured quantity of spores into sterilised cans containing moist sand before putting the larvae into the cans. The two methods were equally effective in securing infection. In one series of tests with the Idaho strain of *M. anisopliae,* increasing the amount of inoculum to six times the normal quantity increased the mortality of the wireworms from 32 to 57 per cent. There was a wide variation in the time required for the wireworms to become infected, and since they showed infection soon after moulting, they were apparently susceptible to it only at the time of ecdysis. Infection and mortality were consequently prolonged over a period of several months after treatment of the sand. All *Metarrhizium* spores were dead in old cultures after 18 months. The Amara strain of *M. anisopliae* had little or no virulence for wireworms, the Idaho strain caused about 50 per cent. mortality and *M. brunneum* about 72 per cent. Although *M. brunneum* had been in artificial culture for seven years before the end of the experiments, it showed no reduction in virulence.

It is concluded that it might be desirable to seek strains of entomogenous fungi that are specially virulent for different species of insects ; the hyphomycetous fungi are preferable to the Entomophthoraceae as they are easily cultured and their virulence to insects is not impaired by artificial culture over long periods [*cf. R.A.E.,* A **39** 180].

DOUTT (R. L.). **The Parasite Complex of *Furcaspis oceanica* Lindinger.**—*Ann. ent. Soc. Amer.* **43** (1950) no. 4 pp. 501–507, 3 figs., 2 refs. Columbus, Ohio, 1951.

Descriptions are given of the adults of both sexes of *Anabrolepis oceanica* and *Ablerus palauensis*, spp. n. *Anabrolepis* was found during a survey of the western Caroline Islands, parasitising the red coconut scale, *Furcaspis oceanica* Ldgr. on Ulithi Atoll, Yap and the Palau Islands. The population of the scale was low, and no colonies free from the parasite were observed. Examples of it were shipped to Saipan, Mariana Islands, where the scale was abundant and without effective natural enemies, and released there in September and November 1948. The adults probed the scales and presumably oviposited, but it is not known whether the species became established. *Ablerus palauensis* was reared from scale material in the Palau Islands, and as it was always associated with *Anabrolepis*, it is presumed to be a hyperparasite. *Marietta carnesi* (How.) emerged from colonies of *F. oceanica* on Ulithi Atoll, and is probably also a hyperparasite. It is known to attack *Comperiella bifasciata* How., a primary parasite of Diaspine scales that is widespread in Micronesia.

HARDY (D. E.). **Studies in Hawaiian Fruit Flies (Diptera, Tephritidae).**—*Proc. ent. Soc. Wash.* **51** no. 5 pp. 181–205, 57 figs., 5 refs. Washington, D.C., 1949.

The author describes the eggs, three larval instars, pupae and adults of *Dacus ferrugineus dorsalis* Hend., *Dacus cucurbitae* Coq. and *Ceratitis capitata* (Wied.), which are of economic importance on fruits and vegetables in Hawaii [*cf. R.A.E.*, A **36** 249 ; **38** 316 ; **39** 239], dealing mainly with the characters that are considered of most importance in differentiating them in the various stages of their life-cycle, and gives keys to the adults, eggs, third-instar larvae and pupae.

SEVERIN (H. H. P.). **Location of Curly-top Virus in the Beet Leafhopper, *Eutettix tenellus*.**—*Hilgardia* **17** no. 17 pp. 545–551, 3 figs., 12 refs. Berkeley, Calif., 1947.

Transmission of the curly-top virus of beet by the leafhopper, *Circulifer* (*Eutettix*) *tenellus* (Baker), sometimes occurs many days after the insect has acquired the virus by feeding on an infected plant. In tests to determine where it was stored in the insect meanwhile [*cf. R.A.E.*, A **26** 445], previously non-infective leafhoppers transmitted the virus to healthy beet seedlings after feeding on nutrient solutions containing blood or crushed stomach or salivary glands of infective insects or on filtrates prepared from these organs, but not when the ovaries dissected from infective females were used. Virus in the saliva injected into a feeding solution by infective leafhoppers was also recovered by previously non-infective ones and transmitted to beet seedlings.

SEVERIN (H. H. P.) & LITTLE (D. H.). **Spinach Yellow Dwarf.**—*Hilgardia* **17** no. 17 pp. 553–562, 2 pls., 15 refs. Berkeley, Calif., 1947.

Spinach plants growing near San Pablo, California, were found to be suffering from a hitherto unknown virus disease referred to as spinach yellow dwarf. The symptoms and properties of the virus are described ; in experiments, it was transmitted mechanically to ten horticultural varieties of spinach but not to plants of 24 other species in 13 families. Since large populations of *Myzus persicae* (Sulz.) were observed in the fields near San Pablo, the ability of that Aphid to transmit the virus was tested. Apterae were used. When single non-infective individuals were allowed to feed for five minutes on diseased plants and then for five on healthy ones, two infections were obtained with 25 Aphids, and when batches of 20 Aphids reared on diseased plants were transferred to healthy ones, 40 per cent. of the latter became infected, as compared with 76 per cent. by mechanical inoculation of material from the diseased plants. Batches of 20 Aphids transmitted the virus from diseased to healthy plants only during the first day after transfer, and five batches transferred hourly for ten hours to successive sets of healthy spinach infected five plants during the first hour, two during the second and none thereafter.

SEVERIN (H. H. P.). **Viruses that induce Breaking in Color of Flower Petals in Pansies and Violas.**—*Hilgardia* **17** no. 18 pp. 577–588, 6 pls. (1 col.), 1 fig., 19 refs. Berkeley, Calif., 1947.

ESSIG (E. O.). **Aphids feeding on violaceous Plants in California.**—*T. c.* pp. 595–617, 7 figs., 63 refs.

The first of these papers contains descriptions of the symptoms induced by three viruses that cause breaking in colour of flower petals of pansies (*Viola tricolor* var. *hortensis*) and violas (*V. cornuta*). Of these, celery calico and western cucumber mosaic occur in California, where they have proved injurious, but common cucumber mosaic is not known there. Celery calico is common in the coastal fog belt and also occurs in the hot interior regions, whereas western cucumber mosaic occurs only in the interior.

Of the Aphids that have been reported to occur naturally on pansy and viola in California, *Aphis gossypii* Glov., *Myzus circumflexus* (Buckt.), *Macrosiphum* (*Myzus*) *solani* (Kalt.) and *Idiopterus* (*Micromyzus*) *violae* (Perg.) transmitted the celery-calico virus from pansy, viola and celery to pansy and viola, and transmission of this virus from celery to pansy or viola was also obtained with *A. apigraveolens* Essig, *A. apii* Theo., *A. ferruginea-striata* Essig, *A. middletonii* Thos., *Cavariella capreae* (F.), *Myzus persicae* (Sulz.) and *Hyadaphis sii* (Koch) (*Rhopalosiphum conii* (Dvdn.)), which breed on celery under natural conditions, but short- or long-winged males of *Macrosteles divisus* (Uhl.) did not transmit it from viola to viola. *A. gossypii*, *A. fabae* Scop. (*rumicis*, auct.) and *Myzus persicae* have been shown to transmit the virus of western cucumber mosaic.

Field investigations showed that the celery-calico virus was disseminated with plants grown in nurseries in which no sprays were applied against Aphids, and that spraying pansies, violas and other susceptible economic plants weekly until the drying of the vegetation on the foothills, from which many species of Aphids fly, controlled the two diseases. Treatment can be discontinued during the summer as the Aphids do not multiply during hot weather. Nicotine sulphate has proved effective. It should be applied to the lower surfaces of the leaves, and all plants showing breaking of colour should be removed and burnt.

The second paper contains information on six species of Aphids that have been recorded on *Viola* spp. in California. This includes detailed descriptions, unless these have already been given [*cf. R.A.E.*, A **27** 590], and information on the nomenclature, distribution and food-plants of *Macrosiphum onobrychis* (Boy.) (*pisi* (Kalt.)), *Aphis gossypii*, *M. solani*, *Myzus circumflexus*, *M. ornatus* Laing and *Idiopterus violae*. A list of other Aphids that have been reported as feeding on violas, pansies or other violaceous plants is appended. *Myzus persicae*, which transmitted the virus of celery calico to pansy in the experiments described in the first paper, does not appear to have been recorded as regularly feeding and reproducing on pansy or viola, though it has been listed on more than 200 food-plants.

DeLong (D. M.) & Severin (H. H. P.). **Characters, Distribution, and Food Plants of Leafhopper Species in** *Thamnotettix* **Group.**—*Hilgardia* **18** no. 4 pp. 185–199, 1 col. pl., 8 figs., 12 refs. Berkeley, Calif., 1948.

Severin (H. H. P.). **Transmission of California Aster-yellows Virus by Leafhopper Species in** *Thamnotettix* **Group.**—*T. c.* pp. 201–216, 1 col. pl., 15 refs.

In the first of these papers, descriptions are given of the adults of *Idiodonus heidemanni* (Ball), *I. kirkaldyi* (Ball), *Colladonus geminatus* (Van D.), *C. montanus* (Van D.), *C. commissus* (Van D.), *C. flavocapitatus* (Van D.), *Friscananus intricatus* (Ball), *F. rupinatus* (Ball) and *F. rupinatus* var. *brunneus*, n., with notes on their distribution and food-plants in California, and on cross-breeding experiments from which it is concluded that another supposed species is a synonym (colour variation) of *I. heidemanni*. [P. W. Oman, in a subsequent work (*R.A.E.*, A **39** 4), considers that this conclusion on the synonymy of *I. heidemanni* was invalid, because the supposed species with which it was crossed was misidentified. He also considers that *Friscananus* is congeneric with *Colladonus*, citing *C. intricatus* and *C. rupinatus* as new combinations, but does not mention *rupinatus* var. *brunneus*, though it would appear to require a new name in *Colladonus*, as he considers *Thamnotettix brunneus* Osb. to be a synonym of *C. belli* (Uhl.). He includes *I. kirkaldyi* in *Colladonus*.]

In the second paper, the author records experiments in which all these Jassids transmitted the virus of California aster yellows [*cf.* also **39** 402], but *C. mendicus* (Ball) did not. In tests with single males and females, *C. geminatus*, *C. montanus*, *C. commissus*, *F. intricatus* and *F. rupinatus* transmitted it to celery but not aster, *I. heidemanni* to celery and aster, and *C. flavocapitatus* and *F. rupinatus* var. *brunneus* to celery, the only plant on which they were tested. *I. kirkaldyi* was a very inefficient vector ; single individuals did not infect either celery or aster, but four adults that were kept on diseased celery for 66 days and then transferred to successive healthy celery plants each week until the last adult died infected two of the seven plants infested. Batches of 5–25 males or females that were kept on diseased celery for 10–14 days failed to transmit the virus to healthy celery, and similar numbers of adults failed to transmit it from infected to healthy aster. Tests in which batches of 20–40 males of *I. heidemanni* were transferred to the two plants alternatively showed that celery was more readily infected than aster, and increasing the number of individuals in a batch or the period of exposure on healthy plants increased the transmission percentage with celery but not aster ; females caused more infection than males.

The minimum latent periods for the virus in 11 batches of 100 males of *C. geminatus* and in 10 batches of 100 adults of *C. montanus* were 11–36 and 8–40 days, respectively. One male of *I. heidemanni* transmitted the virus to a second aster plant after an interval of 11 days, but two males and one female of *C. montanus* produced only initial infections. Two females of *C. commissus* retained the virus for 27 and 6 days after the first transmission and produced 12 and 3 infections, respectively, whereas 11 other adults induced only initial infections.

The virus of curly-top was not transmitted to beet by *C. geminatus*, *C. montanus*, *C. commissus*, *I. heidemanni* or *F. rupinatus*, and the virus that causes Pierce's disease of grape vine and lucerne dwarf was not transmitted by the first three of them.

Gunther (F. A.). **Sample Manipulation and Apparatus useful in estimating Surface and Penetration Residues of DDT in Studies with Leaves and Fruits.** —*Hilgardia* **18** no. 6 pp. 297–316, 7 figs., 12 refs. Berkeley, Calif., 1948.

The following is virtually the author's summary. Because DDT applied in the field is known to penetrate certain leaves and fruits [*cf. R.A.E.*, A **35** 123], empirical techniques for studying the magnitudes of both penetration and surface residues have been evolved and applied successfully since early 1943. The fruits considered in the present report include apples, pears, avocados, *Citrus* varieties, olives, peaches and plums. General techniques for the sampling and manipulation of leaves, and specific techniques for the sampling and manipulation of the various fruits, are discussed in detail. Estimations of the DDT in or on the leaves or fruits were made with the aid of the dehydrohalogenation method of analysis, modified for efficient mass production consistent with reasonable sensitivity. The major modification in this connection was the adoption of an electrometric titration for the chloride ion liberated from the DDT.

A detailed description is also given of the design and operation of a photoelectric arealimeter for the measurement of surface areas of irregular planar objects such as leaves.

SMITH (L. M.) & STAFFORD (E. M.). **The Bud Mite and the Erineum Mite of Grapes.**—*Hilgardia* **18** no. 7 pp. 317–334, 10 figs. Berkeley, Calif., 1948.

Before 1938, *Eriophyes vitis* (Pgst.) had been known in California to produce blisters on the leaves of grape vine, but it was found in that year also causing injury by infesting the spur buds. These two types of damage are widespread in the State. The mites causing them are considered to represent distinct physiological strains of *E. vitis*, referred to as the erineum and bud-mite strains, respectively. Examples of *E. vitis* possibly representing a third strain were found near Modesto in 1945 curling the leaves of the variety Black Corinth.

Adults of the erineum strain overwintered beneath the bud scales and migrated to the lower surfaces of the young leaves in spring, where they fed on the epidermis in small groups, causing the formation of blisters on the upper surfaces. The ventral surfaces of the blisters became covered with dense growths of abnormal curled hairs (erinea), among which several generations of the mite developed before autumn, when the adults migrated to their winter quarters. Little damage of economic importance is caused by this strain, since the mites are usually controlled by the sulphur dust applied as fungicide.

Mites of the bud-mite strain overwintered deep in the spur buds and migrated to the axils of the leaves and into the new buds when the canes were about 6 ins. long. Infestation by them caused death of overwintering buds, shortening of the basal internodes, flattening of the canes, the death of terminal buds on new canes, and witches'-broom growth of new shoots. Injury of these kinds has been observed in California for at least 20 years, and the mites of the strain causing it were shown to have lost the habit of producing leaf erinea. Eggs, young mites and adults were repeatedly found beneath bud scales, and all attempts to rear individual mites in small cages attached to leaf surfaces failed. Its concealed habitat gives the strain a high chance of survival, and it seems likely that it has been selected from the erineum strain by the lethal action of sulphur on the latter. The bud-mite strain causes considerable loss of crop. The dwarfing of the basal nodes and loss of inflorescences do not adversely affect the vigour of the vines, as subsequent growth is usually enough to produce an abundant leaf canopy, but when spur buds are killed during the winter, the plants are seriously injured. A spray of 3 gals. oil emulsion and 5 gals. lime-sulphur solution per 100 gals. water, applied in the autumn of 1939, gave good control on vines that still retained their leaves but was useless on those that had lost them.

Mites of the supposed leaf-curl strain were successfully transferred to potted vines of three other varieties, on which they fed in the axils of the larger leaf veins and at the overlap of leaf serrations, but died out during the winter. They caused the growth of a few abnormal hairs but no typical galls. Leaf-curl developed on one of the three varieties, and also on one plant of a fourth variety growing near.

SMITH (L. M.) & SUMMERS (F. M.). **Propagation of the Oriental Fruit Moth under central California Conditions.**—*Hilgardia* **18** no. 10 pp. 369–387, 14 refs. Berkeley, Calif., 1948.

The following is largely based on the author's introduction and summary. Since 1943, small populations of *Cydia* (*Carpocapsa*) *molesta* (Busck) have been found in several widely scattered peach-growing localities in the San Joaquin and Sacramento valleys of central California [*cf. R.A.E.*, A **36** 397, etc.], where it was thought that the hot, dry summers and mild, foggy winters, the extensive practice of irrigation and the long growing season might affect the development of the moth. In tests in the insectary to determine whether the hot summer climate retards its propagation sufficiently to reduce the potentiality of the moth as a pest, it was found that the adults paired on the day of emergence and the females oviposited 24 hours later, and that individuals of both sexes prevented from pairing remained fertile for relatively long periods. One male usually fertilised only one female during a period of 12 hours, although additional females present occasionally laid small numbers of non-viable eggs. Females fertilised by one or more males during one 12-hour period oviposited normally thereafter in the absence of males. When two stocks of moths from southern California (Orange County) and central California (Tulare county) were reared and kept under the same conditions, females of the former deposited about twice as many eggs as those of the latter. Oviposition tests with two additional stocks from Fresno County, central California, showed that these did not differ clearly from each other or from the Tulare stock. Comparison of the numbers of eggs deposited by females during 7-day periods between 18th April and 9th September 1946 showed that the southern Californian and Tulare stocks reached their highest averages during the hottest part of the summer (10th July to 8th August), whereas the third, from Fresno County, oviposited about equally in hot or cool weather.

When eggs affixed to wax paper were kept under uncontrolled conditions, the percentages that hatched varied inversely with the average temperature. The highest percentage hatch in individual samples was about 95, whereas the average percentages among eggs kept at the highest average summer temperature varied from 74·5 for the Tulare stock to 67·6 for the Fresno stock. There were significant differences in the viability of eggs of the three strains.

During hot weather, 83·6–96·1 per cent. of the eggs on living peach leaves and 81·9–93·1 per cent. of those kept on wax paper under laboratory conditions hatched. The viability of the eggs on wax paper was slightly increased by increasing atmospheric moisture, but differences in this accounted only in part for differences between the proportions of eggs hatching on dry wax paper and on transpiring peach leaves. The viability of eggs deposited on peach leaves was slightly greater on the lower than on the upper surfaces and was not greatly reduced by hot-weather conditions, more than 90 per cent. hatching in 26 of 30 samples tested between 16th June and 15th August, 1946.

It is concluded that the reproduction of *C. molesta* is not seriously impaired by the summer climate of central California.

SEVERIN (H. H. P.) & TOMPKINS (C. M.). **Aphid Transmission of Cauliflower-mosaic Virus.**—*Hilgardia* **18** no. 11 pp. [1+]389–402, 2 pls., 1 fig., 14 refs. Berkeley, Calif., 1948.

An account is given of further investigations in California on the transmission by Aphids of the virus of cauliflower mosaic [*cf. R.A.E.*, A **25** 756]. Of the Aphids that breed on cauliflower under natural conditions [*cf.* next abstract], *Brevicoryne brassicae* (L.) from field colonies on infected brussels sprouts and cauliflower transmitted the virus to cauliflower and to cauliflower and annual stock (*Matthiola incana* var. *annua*), respectively. In the laboratory, *B. brassicae* proved a more efficient vector than *Rhopalosiphum pseudobrassicae* (Davis) or *Myzus persicae* (Sulz.) in tests with single insects on cauliflower ; mechanical inoculation was the most effective method of transmitting the virus. None of 21 varieties of cauliflower experimentally infected by *B. brassicae* or *M. persicae* was resistant to the disease. When lots of up to 20 Aphids of these species that had fed on diseased cauliflower were transferred to fresh plants daily for three days, all produced infections on the first day, but none on the second or third. Two of three batches of 20 *B. brassicae* transferred hourly transmitted the virus during the first and second hours and one during the first hour only ; batches of the other two species transmitted the virus during the first hour only. When single Aphids were allowed to feed for 5–10 minutes on an infected cauliflower and then for 5–10 minutes on a healthy plant and for ten minutes on each of five more healthy plants, 25 of 98 *B. brassicae*, 5 of 46 *R. pseudobrassicae* and 5 of 46 *M. persicae* produced infection in the first healthy plant, one example of *B. brassicae* failed to infect the first two and infected the third, and one of *M. persicae* infected the first and third plants. *B. brassicae* and *M. persicae* recovered the virus from inoculated cauliflower plants many days before the first symptom appeared.

Tests of single Aphids of species that have not been found breeding on cauliflower under natural conditions showed that *Aphis apii* Theo., *Cavariella capreae* (F.), *Macrosiphum onobrychis* (Boy.) (*pisi* (Kalt.)), *Myzus circumflexus* (Buckt.) and *Macrosiphum solani* (Kalt.) (*Myzus convolvuli* (Kalt.)) were more effective vectors of the virus than *B. brassicae*, *R. pseudobrassicae* or *Myzus persicae*. *A. apigraveolens* Essig, *A. ferruginea-striata* Essig, *A. gossypii* Glov., *A. middletonii* Thos. and *Hyadaphis sii* (Koch) (*R. conii* (Dvdn.)) also transmitted the virus, but *A. fabae* Scop. (*rumicis*, auct.) did not.

Essig (E. O.). **The most important Species of Aphids attacking Cruciferous Crops in California.**—*Hilgardia* **18** no. 11 pp. [1+]405–422, 5 figs., 67 refs. Berkeley, Calif., 1948.

Aphids cause great damage to cruciferous crops by sucking the sap, thus weakening, stunting and sometimes even killing the plants, and still greater losses by transmitting viruses, which may destroy the plants over considerable areas. *Brevicoryne brassicae* (L.), *Rhopalosiphum pseudobrassicae* (Davis) and *Myzus persicae* (Sulz.), which breed on the plants, are responsible for most of the damage in California. All three species are cosmopolitan and are to be found generally throughout the ranges of their food-plants. In this paper, the author summarises the salient facts on their synonymy, characteristics, life-histories, distribution and food-plants, as a basis for studies on the transmission of viruses by them and their control.

Severin (H. H. P.) & Drake (R. M.). **Sugar-beet Mosaic.**—*Hilgardia* **18** no. 13 pp. 483–521, 8 pls., 1 fig., many refs. Berkeley, Calif., 1948.

The authors describe the symptoms of sugar-beet mosaic in various plants and the characteristics of the virus that causes it and review the literature on its importance, transmission and host plants. The disease causes losses of seed crops of beets in California, but is not otherwise of economic importance there. In the authors' investigations, beet (including sugar-beet, mangel and red beet), Swiss chard, spinach, New Zealand spinach (*Tetragonia expansa*), and *Beta maritima* were found naturally infected, and the virus was transmitted experimentally to tobacco and *Kochia scoparia* var. *trichophila*. The incubation period of the disease in sugar-beet averaged about eight days in the greenhouse and 25 days out of doors.

All attempts to transmit the virus with insects other than Aphids failed. When Aphids were colonised on infected beet and later transferred to healthy beet, the virus was transmitted by *Aphis middletonii* (Thos.), *Macrosiphum onobrychis* (Boy.) (*pisi* (Kalt.)) and *Myzus persicae* (Sulz.), but rarely by *A. fabae* Scop. (*rumicis*, auct.) and not by *Pemphigus* (*Prociphilus*) *betae* Doane, from the roots. It was also transmitted from and to beet by *A. apigraveolens* Essig, *A. apii* Theo., *A. ferruginea-striata* Essig, *A. gossypii* Glov., *A. medicaginis* Koch, *A. pomi* Deg., *Brevicoryne brassicae* (L.), *Cavariella capreae* (F.), *Rhopalosiphum pseudobrassicae* (Davis), *Myzus solani* (Kalt.) and *Hyadaphis sii* (Koch) (*R. conii* (Dvdn.)), which do not breed on that plant under natural conditions. In tests with *M. persicae*, the percentages of plants infected increased with the number of Aphids per plant, but single Aphids produced no infection, and infections were produced after feeding periods of only five minutes on infected and healthy plants. Six of ten groups of 20 Aphids infected beet during the first hour after transference from diseased plants, one of these and three others during the second, one other during the third and none later, but it is possible that the Aphids may remain infective for longer under natural conditions during the winter. No infections were obtained by injecting the cornicle exudate from infective *M. persicae* into healthy beet.

Beets showing symptoms of both mosaic and curly-top are common in the field, especially during outbreaks of Aphids and the leafhopper, *Circulifer* (*Eutettix*) *tenellus* (Baker), the vector of the latter. When previously non-infective examples of *M. persicae* and *C. tenellus* were allowed to feed on a plant infected with the two viruses and later transferred to healthy beet, the former transmitted mosaic only and the latter curly-top only.

Severin (H. H. P.) & Freitag (J. H.). **Outbreak of Western Cucumber Mosaic on Sugar Beets.**—*Hilgardia* **18** no. 14 pp. 523–530, 4 figs., 8 refs. Berkeley, Calif., 1948.

A severe outbreak of western cucumber mosaic occurred on sugar-beet in the middle of the San Joaquin Valley, California, in 1940, when enormous flights of *Myzus persicae* (Sulz.) from the plains and foothills of the Inner Coast Range led to heavy infestation in the fields. The symptoms of the disease on naturally and experimentally infected beets are described. In experiments, blistering of the youngest leaves proved a reliable criterion of systemic infection. *Aphis gossypii* Glov., *A. fabae* Scop. (*rumicis*, auct.) and *M. persicae*, which occur on beet under natural conditions, all transmitted the virus in the laboratory. *M. persicae* is the most important vector to sugar-beet, and *A. gossypii* is an efficient vector to melons and cucumbers. *A. fabae* rarely transmits the virus to beet. A list of economic plants that were shown to be naturally infected with the virus is appended.

Severin (H. H. P.) & Tompkins (C. M.). **Aphid Transmission of Mild Mosaic Virus of annual Stock.**—*Hilgardia* **18** no. 15 pp. 539–547, 4 pls., 11 refs. Berkeley, Calif., 1948.

The following is based on the authors' summary. Laboratory tests with Aphids in groups of 20 showed that the mild-mosaic virus of annual stock (*Matthiola incana* var. *annua*), which causes breaking in colour of the flowers and has resulted in severe losses in California, was transmitted by *Aphis medicaginis* Koch, *Brevicoryne brassicae* (L.), *Capitophorus* (*Myzus*) *braggi* (Gill.), *Myzus persicae* (Sulz.) and *Rhopalosiphum pseudobrassicae* (Davis), of which only the last breeds on stock under natural conditions. *R. pseudobrassicae* from naturally infected stock transmitted the virus to healthy stock but not to cauliflower. Several infections were obtained with single individuals of *R. pseudobrassicae* and *M. persicae* that fed for 0·5, 1, 2, 5 or 10 minutes on leaves from infected stock after fasting for two hours, and were then transferred to healthy plants, but none with *R. pseudobrassicae*, *M. persicae* and *B. brassicae* tested singly without fasting and with longer periods on the infected plants. When single examples of *R. pseudobrassicae* that had fed for 5–10 minutes on infected plants after fasting for 30 minutes were allowed to feed for 5–10 minutes on each of 5–6 successive healthy stock plants, infections were produced in the first healthy plants only. Batches of 20 *R. pseudobrassicae* had lost their infectivity by the fourth day after transfer from infected to previously healthy stock plants, but became infective again if kept on the latter for 7–13 days.

SEVERIN (H. H. P.). **Additional Virus Diseases of Spinach in California.**—*Hilgardia* **18** no. 15 pp. 553–558, 9 pls., 14 refs. Berkeley, Calif., 1948.

The author records the finding in California of spinach plants naturally infected with the viruses of sugar-beet mosaic, western cucumber mosaic and celery calico, and describes the symptoms caused. These are so similar that the viruses can only be distinguished by transferring them to beet. *Myzus persicae* (Sulz.) was shown by Bacon & Walz to be the most abundant Aphid on spinach in California. *Aphis fabae* Scop. (*rumicis*, auct.) occasionally bred on spinach, and winged forms of *Macrosiphum onobrychis* (Boy.) (*pisi* (Kalt.)) occurred but did not breed on it. Since *Myzus persicae* has been shown to transmit all three viruses and *A. fabae* rarely transmits the first two, it is concluded that the principal vector was probably *M. persicae*.

SMITH (L. M.) & KIDO (G. S.). **The Biology of the Strawberry Rootworm in California.**—*Hilgardia* **19** no. 2 pp. 25–42, 8 figs., 3 refs. Berkeley, Calif., 1949.

The Eumolpid, *Paria canella quadrinotata* (Say), is widely distributed in the United States, where it attacks a wide variety of plants, and also occurs in Canada. In California, it attacks only strawberries [*cf. R.A.E.*, A **30** 431] and raspberries, of which it is a serious pest, and investigations on its bionomics were carried out in the Santa Clara Valley in 1939–42. The following is partly based on the authors' summary of the results.

No males of *P. c. quadrinotata* were found, and the females reproduced parthenogenetically. Only one generation was produced a year, but some of the adults overwintered twice. Adults left their hibernation sites on or in the ground in mid-February, fed on the leaves of strawberry or raspberry, and oviposited from late March or early April until the end of September, depositing an average of 125 eggs each, usually in crevices. Larvae were present from mid-April until the end of October, and pupae from mid-June until early November. The larvae entered the soil, fed on the roots and pupated in cells in the soil. The egg, larval and pupal stages averaged 12, 57·8 and 12·3 days at 70°F., 7·2, 34·5 and 6·8 days at 80°F. and 6·3, 28·4 and 5·9 days at 85°F., and the adults did not oviposit until the year following that in which they emerged. A method is given for computing the amounts of food consumed during the adult stage from the frass produced. When large numbers of beetles were kept at constant temperatures of 45–90°F. and relative humidity of 73 per cent., the higher temperatures led to earlier development of the ovaries and increased egg production.

SMITH (L. M.) & KIDO (G. S.). **The Raspberry Leaf Sawfly.**—*Hilgardia* **19** no. 2 pp. 43–54, 7 figs., 3 refs. Berkeley, Calif., 1949.

Priophorus rubivorus Rohw. has been present on raspberry in California since before 1928 ; it has also been recorded from Oregon and Washington and is probably native to the Pacific Coast of the United States. Observations on its bionomics showed that the eggs were laid singly in cavities in the petioles or the tender bark of new shoots and hatched in 7–9 days in June at San José. The larvae devour the leaf tissue from the under surface, preferring the older leaves in the deepest shade in the centre of the bush, and become full-fed in 4–6 weeks. They spin their cocoons in the soil, usually in worm holes in the highest, driest clods and sometimes 10–20 ft. from the plant they have left. The period spent in the cocoon was 5–8 days at room temperatures in mid-summer. Only females were collected, and unfertilised examples oviposited within 24 hours of emergence. Adults survived for only a few days in captivity.

The sawfly is present in almost all the raspberry plantings in the central district of California. The winter is passed by the larvae and pupae in the cocoon, and the adults emerge and oviposit in April. Larvae of the first generation spin their cocoons in May and early June, and the first adults appear about the middle of June. Larvae of the second generation are most numerous towards the end of July and pupate by early August, and the adults appear about the middle of August. Third-generation larvae are present throughout September. Some larvae of each generation hibernate. The larvae are most abundant and destructive in June and decrease in importance for the rest of the season. Observations in the field showed that raspberry is the preferred food-plant. Youngberries and loganberries were less susceptible, but sometimes suffered commercial damage, and blackberries were seldom injured sufficiently to warrant control measures.

P. rubivorus was sometimes heavily parasitised by *Ptychomyia* (*Bessa*) *selecta* (Mg.) and *Dibrachys cavus* (Wlk.) (*boucheanus* (Ratz.)). Pupae were heavily parasitised by the former in the autumn of 1933, after a serious outbreak; the parasite pupates within the host and emerges in the following spring. *D. cavus* oviposits in the prepupae, and the mature larvae overwinter in the cocoons and pupate there in spring, the adults emerging after a few days. Some 20–25 parasites mature in each cocoon, and a generation was completed in 12 days at room temperatures. *D. cavus* is sometimes hyperparasitic, but field evidence indicated that it seldom, if ever, parasitises *P. selecta* and it was reared in the laboratory as a primary parasite of *Priophorus*.

Notes are given on other sawflies that attack raspberry and may be confused with *P. rubivorus*. These are *Blennocampa rubi* (Harr.), which feeds on the tender foliage at the top of the bush and has been reported from many parts of the United States though apparently not from California, and *Tenthredo xanthus* Nort., which occurs in California but is of little economic importance.

PAPERS NOTICED BY TITLE ONLY.

STAFFORD (E. M.) & BARNES (D. F.). **Biology of the Fig Scale** [*Lepidosaphes ficus* (Sign.)] **in California.**—*Hilgardia* **18** no. 16 pp. 567–598, 15 figs., 18 refs. Berkeley, Calif., 1948. [*Cf. R.A.E.*, A **38** 110.]

GAHAN (A. B.). **A new Mymarid** [*Erythmelus helopeltidis*, sp. n.] **parasitic in Eggs of** *Helopeltis cinchonae* **Mann** [on tea in Malaya] (**Hymenoptera, Mymaridae**).—*Proc. ent. Soc. Wash.* **51** no. 2 pp. 75–76. Washington, D.C., 1949.

SNYDER (T. E.). **Catalog of the Termites** (**Isoptera**) **of the World.**—*Smithson. misc. Coll.* **112** (Publ. 3953) [1 +]490 pp., 32¼ pp. refs. Washington [D.C.], 1949.

GRIFFIN (F. J.). **A Bibliography of the Isoptera** (**Termites**) **1758–1949.**—*J. Soc. Bibliogr. nat. Hist.* **2** pt. 8 pp. 261–368. London, 1951.

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